SEP 29 1910

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American Machinist

A Practical Journal of Machine Construction
Issued Weekly by the Hill Publishing Co., 505 Pearl St., New York

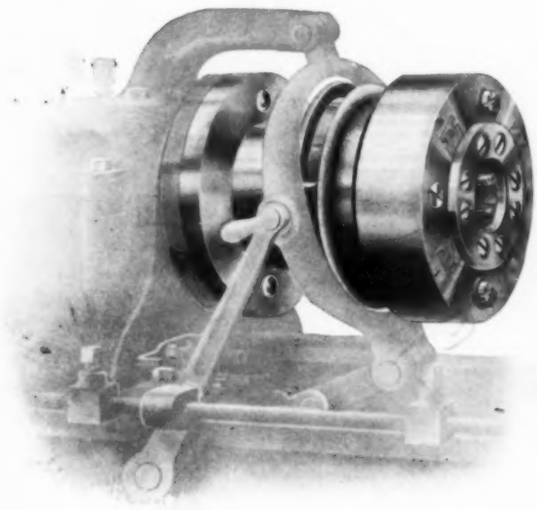
Vol. 33. Editorial Index Page 601 Advertising Index Page 51 No. 39

AT THE EXPOSITION

THE NATIONAL MACHINERY TIFFIN OHIO U.S.A.

OF MODERN BOLT, NUT AND FORGING MACHINERY

August 19—22 and 23



The National Die Head
Used on all National Bolt Cutters

We exhibited and operated a National Die Head which has been operating for 14 *years* in one of the leading R. R. Shops—and giving highly satisfactory service all the while.

We duplicated on this Head the same precision threading that can be secured on any new Die Head.

And to demonstrate the ability of the National Head to maintain size against variations in stock diameter and hardness the Head was equipped with 1-inch Dies and set for a snug fit in a standard U. S. nut.

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The National Machinery Co.

Tiffin, Ohio, U. S. A.

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Six Automatic Reversible Feeds for Drilling and Boring Sixteen Speeds

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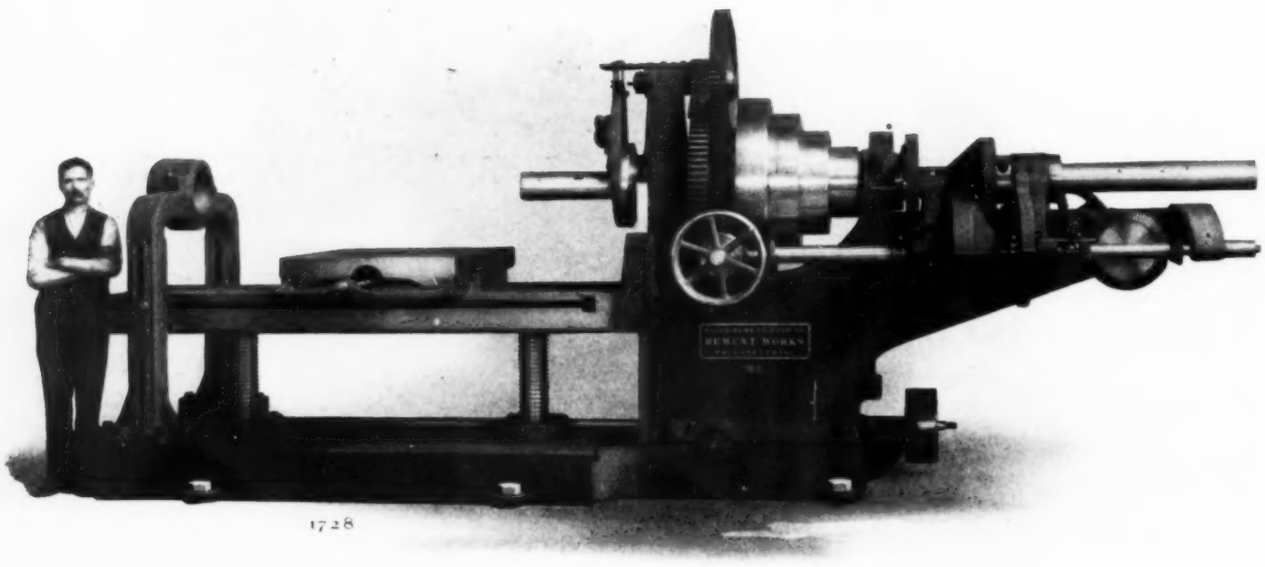

1728

The convenient machine for drilling, boring, facing and tapping irregular castings and forgings without disturbing the original setting.

Particularly efficient on such work as frames, cylinder castings, etc., that have numerous bosses, pads and large bores.

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(*See pages* 43, 44, 45 *and* 46)

Dies for Franklin Castings

By H. C. Skinner*

Two of the dies used in producing intricate castings which would be very difficult to machine. The way in which the dies are made; the operation of the cores; ejecting the casting from the mold when cool and the accuracy required.

*Manager die-casting department, H. H. Franklin Manufacturing Company.

About seventeen years ago the H. H. Franklin Manufacturing Company of Syracuse, N. Y., placed on the market what are known as die castings. In the production of these castings the old form of sand molds was eliminated, and in their place steel dies were used, in which molten metal was cast under pressure. As a result, the castings produced came from the dies in a practically finished form, requiring no machining to fit them for use. Fig. 1 shows a miscellaneous line of small parts die cast by the Franklin Company. These have not been machined in any way, the holes, slots and grooves having all been produced in the operation of casting.

Although die castings are very widely used, little seems to be known of their actual manner of production, especially of the dies in which they are cast. The process is often confused with stamping methods, and the dies are generally considered by the uninitiated as being comparable with stamping dies. This, however, is far from being the case, the dies used for the production of die castings being far more intricate in every way.

A better understanding of die construction would often account for the apparent excessiveness of die cost and might suggest the possibilities of the process as applied to classes of work in which die castings have not been used.

Of the many parts constructed by the Franklin company two are here selected as examples, one a segment of ring used in the building up of the main wheel of a machine constructed for powder manufacture; the other an 88-note tracker bar used on one of the leading makes of piano-player. The latter has been selected on account of the intricacy of the die construction, especially in the way of coring. Both exemplify the extreme accuracy necessary in this line of work.

Making a Cylinder in Parts

Fig. 2 shows a die simple to operate, but requiring great accuracy in construction. The segment shown is a part of a cylinder used in a machine for the manufacture of powder. On account of its large proportions it was impossible to cast this cylinder as a whole, and the use of the ring segment was therefore resorted to. Seven of these segments are required for the complete circle. To produce the cylinder the segments are assembled, one-half of one lapping on one-half of another until a cylinder of the required thickness is formed. The embossed surface of the die acts as cores in the castings so that when two are placed together cylindrical openings are formed for the receipt of pistons and a slight inaccuracy would, therefore, prevent the proper assembling of the device. The exactness of each part of the die is evident when one considers that the die is made up of 58 pieces, not counting dowels, screws, racks and pinions.

A practical toolmaker will readily appreciate the difficulty of constructing such a die, when he considers the fact that the diameter of the cylinder is about $18\frac{7}{8}$ inches and that the diemaker was forced to use compound gearing to get the required number of divisions, the usual inaccuracy in the dividing head increasing the complications.

This die differs from the other in operation in the fact that it is necessary to use an ejector box and plate. On the ejector plate a series of pins is set up; these extend through the body of the die to the face of the casting. The plate is operated by the lever. These pins force the castings from the die much as the

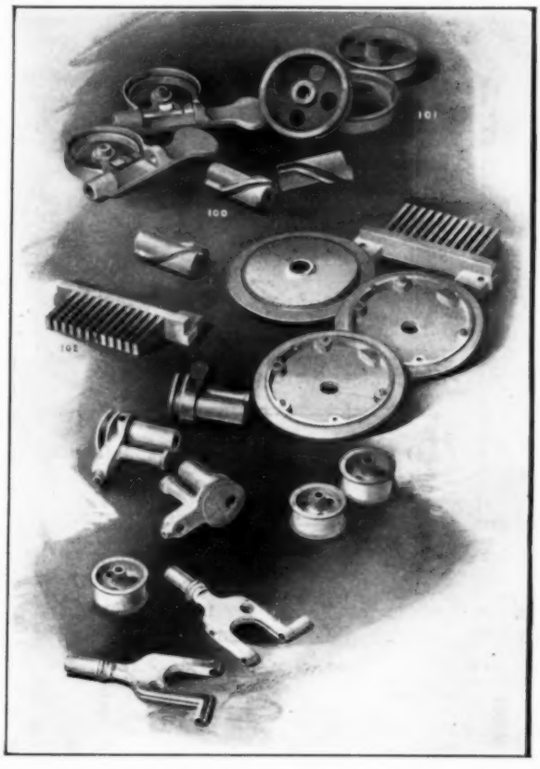

Fig. 1. A Group of Die Castings

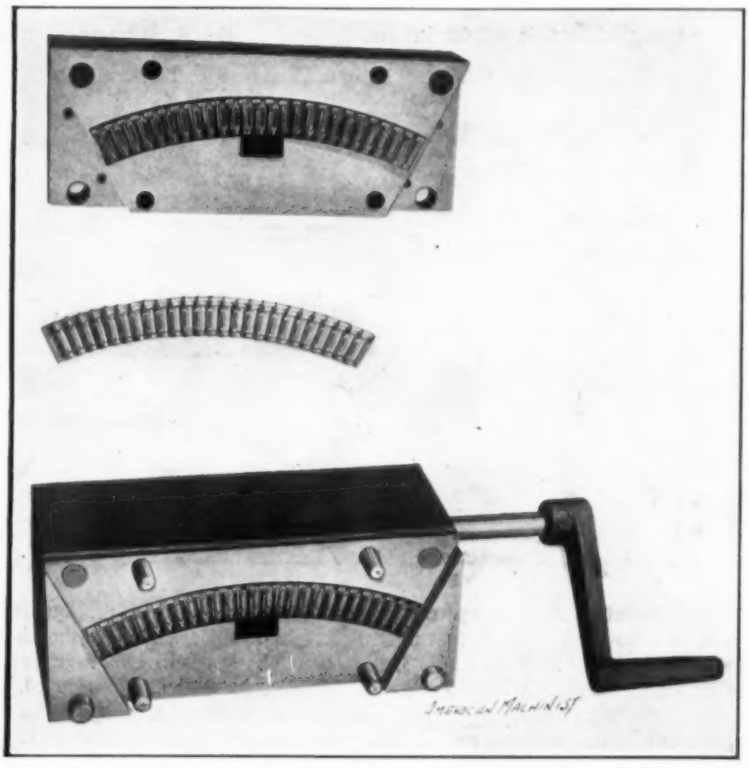

Fig. 2. Die for Casting a Cylinder in Segments

bottom core to be described in Fig. 4; otherwise the operation of the two dies is practically the same.

A More Complicated Die

Fig. 3 represents a die closed, ready to be placed in the vise which holds it on the machine. Holes *A* are the holes for the screws by which the die is secured in place, opening *B* the gate hole through which the metal enters the die, *C* the levers which operate the cores. Fig. 4 shows the same die opened up and showing inside workings. This can be divided as follows: *A* and *B*, the upper and lower die plates respectively; *C*, the gate hole before mentioned; *E* the core holes; the cores being drawn back out of sight by means of levers *D* 1 and 2. *F* a similar set of cores thrust out by levers *D* 3 and 4 as in the operation of casting; *G* set of cores which are operated by levers *D* 5 and 6. These not only act as cores for the straight holes, but also as ejectors by means of which the castings are forced from the die.

Pieces *H* and *I* show two views of the tracker bar produced in the die just described. Anyone familiar with the action of the piano-player can readily understand the extreme accuracy necessary in this part in order to secure a proper action in use.

It will be noticed that, while the cores meet in a straight line on top, they diverge in three directions toward the bottom. This coring would be practically impossible by other than the die-casting process, the majority of tracker bars being made up in sections either from wood or brass stampings.

The casting shown is made in one piece, the manufacture of this piece being simple, as follows: The die is first placed in a vise, closed as shown in Fig. 3, the gate hole *B* being placed directly over the nozzle of the machine. The die is then heated sufficiently to prevent too rapid cooling when the metal is forced into it. The cores are forced upward by means of levers *D*, as shown by cores marked *F* and *G*, and the metal forced into the die under pressure. After the metal becomes set the upper cores are thrown back, as shown at *E*, Fig. 4, and the castings forced out by the combination cores and ejectors *G*.

Where the Workmen Count

While this operation seems comparatively simple, many little points are involved which affect the quality of the casting. Experience has shown that only through the use of high-grade workmen can the best results be secured.

Only a limited idea can be given of the various forms of die construction possible; in other cases dies are used which make it possible to cast accurate threads and other features not often admitted in the production of castings.

Nature of Metal Necessary

The metal must, of course, be of a comparatively low fusing nature in order not to injure the die. Brass and aluminum have been cast but, especially in the case of the former, the action on the surface of the die was such as to make the life very short; and the best results are secured when the metal can be kept at a reasonable temperature.

The range of the process, however, is wide and new uses are constantly being found. The bearings on a majority of motor cars now before the public are die cast. Most of the leading magnetos are built up largely of die castings. In the construction of the new census tabulating machines, which have caused so much interest during the past few months, 64,000 die castings were used.

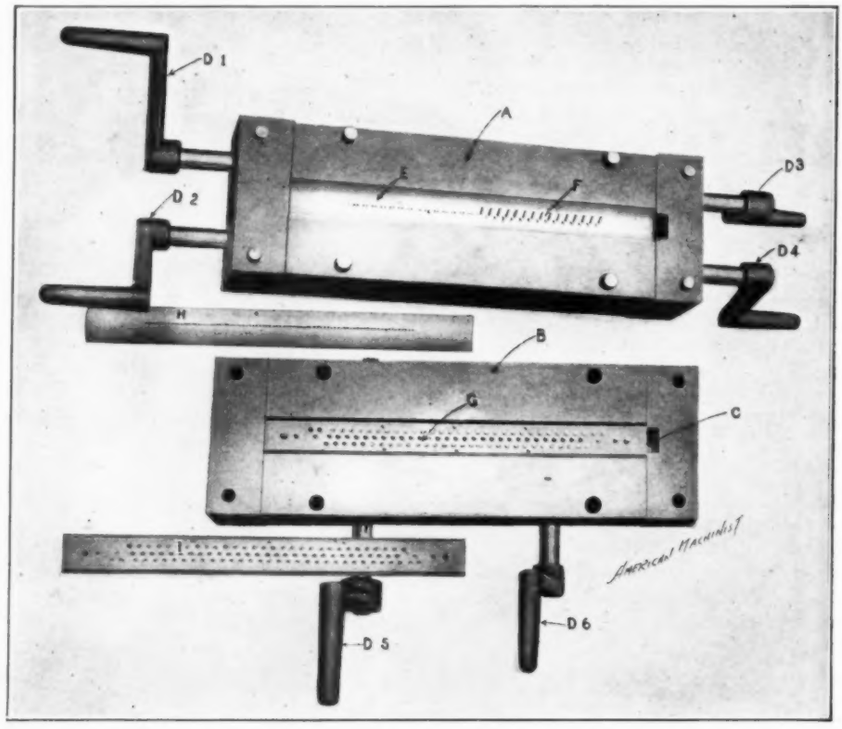

Fig. 4. Details of the Die Showing Cores and Connections

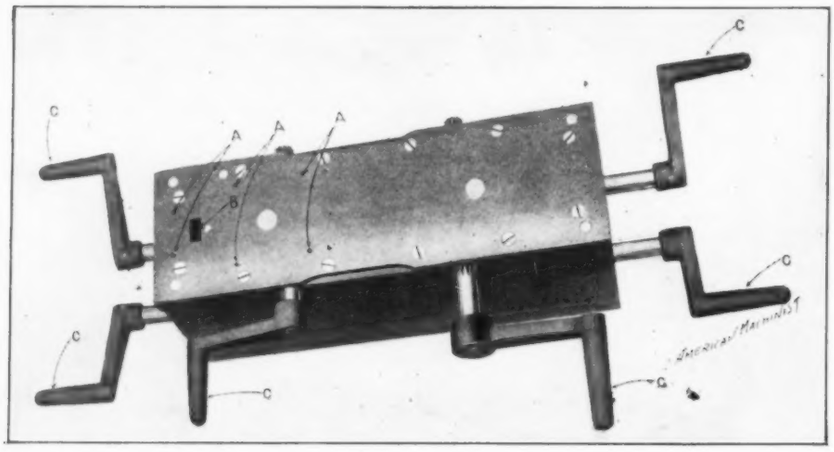

Fig. 3. Die for Piano Player Mechanism

To Square a Number Ending in a Half

The square of a number ending in a half is always equal to the product of the whole number by the next larger whole number, plus ¼. Example: The square of

$3\frac{1}{2}$ is $(3 \times 4) + \frac{1}{4} = 12\frac{1}{4}$.

Square of

$7\frac{1}{2} = (7 \times 8) + \frac{1}{4} = 56\frac{1}{4}$.

Square of

$11\frac{1}{2} = (11 \times 12) + \frac{1}{4} = 132\frac{1}{4}$

Improvised Single-purpose Tools

Editorial Correspondence

Special attachments to engine lathes for turning cam shafts.

Separate attachments for the plain portions and cams.

Boring four cylinders cast together at one operation.

The Westinghouse Machine Company build a large number of four-cylinder automobile motors and have equipped several lathes with special attachments which make them into single-purpose machines for this purpose.

The cam shaft to be turned in this case is made from a drop forging and has enlarged bearings, as can be seen in Fig. 1. The cam shaft is centered and the bearings turned in another lathe. It is then brought to the machines shown in Figs. 1 and 2. Here it is supported on centers and by the large bearings, as can be plainly seen, which hold the shaft firmly while being turned.

A substantial saddle on the lathe carriage carries the tool blocks which are all independently adjustable. The tool blocks at the back of the carriage carry special tools so spaced that when they are fed into the work they face off both sides of the cam and cut down the shoulders at the ends of the bearing. These tools are then backed out and the tools on the front of the carriage are brought up against the work. These tools finish the shaft on its small diameter.

Turning the Plain Portions

For this operation the carriage is fed parallel to the work. The overhanging arm shown on the third tool block, turns a section that is considerably shorter than the rest. This makes it impossible to turn all the sections at one operation. So the tool in the overhanging arm is set well ahead of the other turning tools and consequently comes into action first. This tool hangs down and the point is just high enough above the center so that when the tool is directly over the cam shaft the section is reduced to the correct diameter. With the tool in this position the carriage is then traversed until this section is turned for its entire length.

Then the whole carriage is fed forward until the other tools come up against the small diameters of the cam shaft and the carrier is traversed until the whole

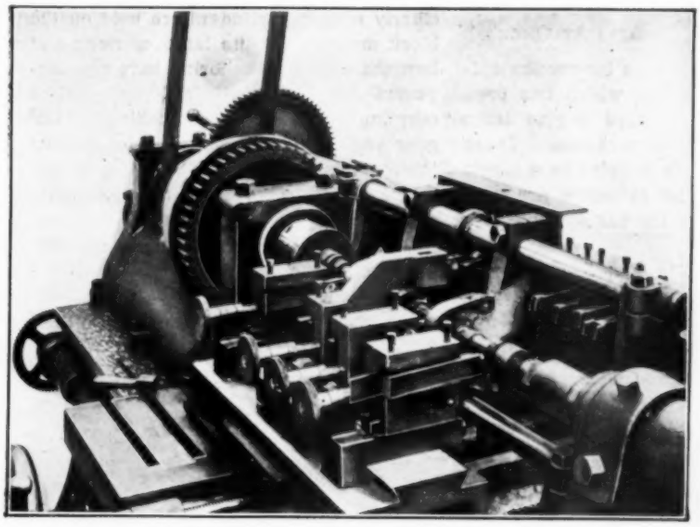

FIG. 1. TURNING THE STRAIGHT PART OF CAM SHAFTS

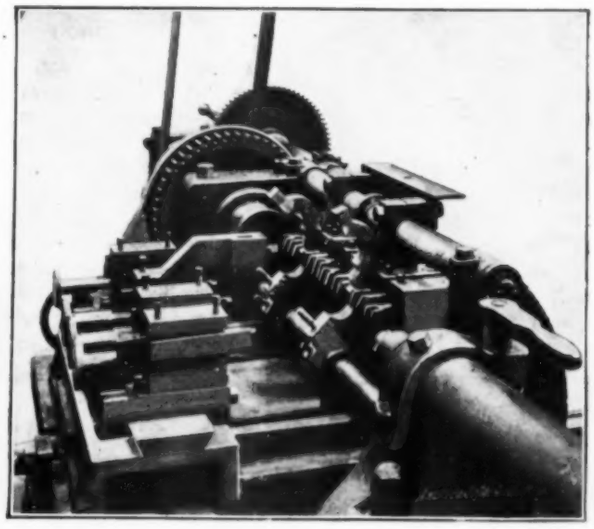

FIG. 2. THE ATTACHMENT OPEN TO SHOW TOOLS IN PLACE

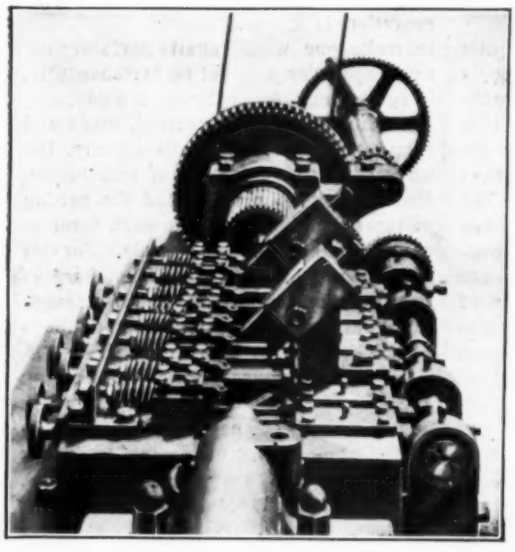

FIG. 3. CAM-TURNING ATTACHMENT EMPTY

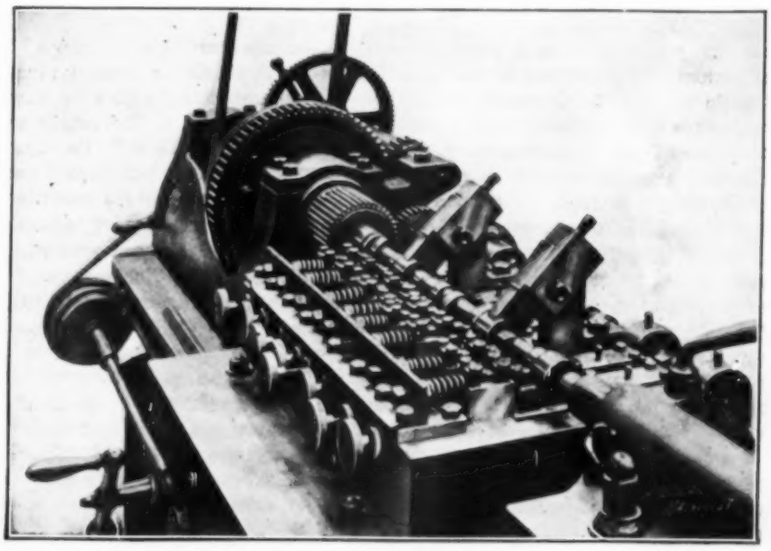

FIG. 4. THE CAM SHAFT IN PLACE

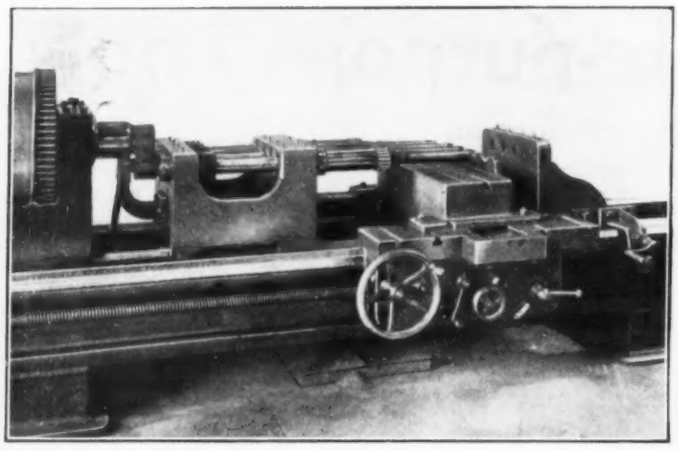

FIG. 5. BORING BAR FOR FOUR CYLINDERS CAST TOGETHER

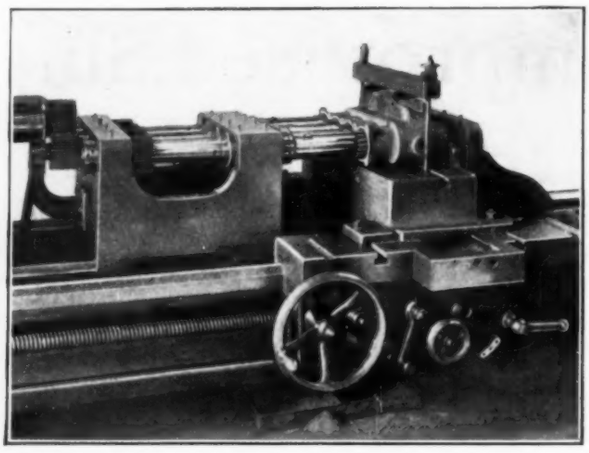

FIG. 6. BORING FOUR CYLINDERS AT ONCE

of the plain section has been turned. This brings the overhanging tool clear of the shaft so that it is entirely out of the way and does not interfere with the other tools in the least.

TURNING THE CAMS

Figs. 3 and 4 show the lathe which has been made over especially for turning these cam shafts. This consists of a substantial fixture mounted on the lathe carriage so as to bring the cutting tools at the correct hight and containing rigid back rests for the central bearing so as to support the shaft against springing.

At the back of these lathes is a substantial attachment carrying the master cam. This master cam shaft is driven by spur gears from a wide face gear on the nose of the lathe spindle. This permits the carriage carrying all the tools as well as the master cam shaft at the back, to be fed a sufficient distance to turn off the entire surface of the cam and still keep the gears in mesh with the main driving gear on the spindle nose.

BORING FOUR CYLINDERS AT ONCE

Figs. 5 and 6 show an interesting cylinder-boring attachment which has been made for a suitable-sized engine lathe for boring four cylinders at once. These are for boring the four holes in a single casting, or when the cylinders are "*en-bloc*," which brings the bar spacing very close together.

As can be seen in Fig. 5, the boring fixture consists of a headstock carrying four boring bars which are driven from a gear on the spindle nose. Each alternate bar is driven in the opposite direction by the gears shown, which makes it possible to have the bars very close.

Fig. 6 shows one of the cylinder castings clamped into place with the four boring bars in position. This shows very clearly how the cylinders are held on the block mounted on the lathe carriage and how the ends of the boring bars are supported by the improvised tail blocks carrying four hardened bushings. The gear and pinion arrangement for moving the regular tail block has been transferred to the new one, so as to make it easily adjustable to any position on the bed. With the rigid bars shown and the firm support at the outer end, this makes a very substantial boring machine and enables these four cylinders to be bored accurately and rapidly.

The Art of Invention

By W. D. Graves

It has been said that the art of invention cannot be taught, but it is certain that before it can be made remunerative there is much to be learned. Inventors, like poets, are born but they are born incomplete. Like machine-knit socks, they are apt to need sewing up at the bottom and stretching at the top.

While the art of origination cannot be taught, it is a talent likely to be a serious financial setback to its possessor unless he learns many things which are capable of being imparted. One must know what is practicable and, as well, what has been done along the contemplated line. Many practical devices have been patented which, for one or more of a multiplicity of reasons, have never been marketed. Many have been placed on the market which, though entirely practical mechanically, have not proved remunerative. Though a thing may appear to you and me a valuable improvement, it may not tickle the fancy of the mass to the extent of causing it to loosen its grip on its shekels. Many an invention has lain dormant for more than the term of a patent (only to be popularly used after the inventor is dead—or worse), because it did not synchronize with the spirit of the times.

An inventor of experience recently said: "It seems as though nine people out of ten, taking hold of a new mechanism, take hold of it wrongly and, if it is breakable, break it." Perhaps he exaggerated slightly, but there is more than a grain of truth in his assertion. The fact is that we, having designed and built a machine or implement, instinctively and unknowingly favor its weak points. When a stranger takes hold of it for the first time, it being different from anything he has used, the chances are quite naturally in favor of his taking hold of it wrongly. These chances should be appreciated and guarded against; hence, on the mechanical side as well as on the selling, a little acquired knowledge of human nature will be far from amiss to the inventor.

The normal state of the average inventor's mind seems to include the impression that complexity in mechanism constitutes merit, whereas the opposite is likely to be the case. The design of a complex machine to perform a given operation is often a simple matter, but to make one which shall perform the same operation and yet be merchantable, is apt to require considerable study.

When a device is conceived, made and found to do its work satisfactorily, the work of the inventor is but well begun. Next comes the pruning and the getting of the remaining parts into such form as can be most economically made. For this work is required knowledge not born in one, practical knowledge of the strength of materials and of the latest methods of working the material in hand.

Weight and susceptibility to packing for shipment are also items of import, in regard to which knowledge may be acquired. The extent of the market in our country is almost beyond conception and, if one can draw ever so lightly from the whole field he will have a gold mine indeed. To do so, however, he must

reckon with transportation over long distances and with rates which have no place in kindergarten arithmetic.

If we look out on the broad sea of mechanical endeavor we see, swimming high on the tide of success, many who have been classed as plungers. If we examine the bottom, however, we will see what appears as a dense growth of weeds with palmated leaves. These are those who, leaping high from the spring board of self-gratulation, have made the plunge without having sounded the water. They stick, head and shoulders in the muddy bottom, with their feet, like submerged lilypads, furnishing shade for the vast army of suckers which fatten on their blood.

High Speed Radial Drilling Attachment

By H. V. Cawthray

An attachment for the radial drill to obtain high speed for drilling small holes in large work.

It often happens that large work may require small holes drilled in it. At the same time it is "set up" under a radial arm drilling machine, for heavy drilling operations. For this work the high-speed attachment shown at Fig. 1 was designed. It runs the drill at three times the spindle speed, so that it is an easy matter to obtain the correct cutting speed for small drills, with a comparatively slow spindle speed.

Referring to Fig. 1, *A* shows the Morse taper spindle, with a hexagon shoulder *B*. It is screwed into the steel driving case *C*, which is shown in elevation at Fig. 2, and inside plan at Fig. 3. This case is machined inside, from the solid, but no doubt, where quantities were likely to be made, a malleable casting would suffice, the annular gear *E* being machine cut, of course. *D* is one of four similar blind set screws for securing the cover *F*, also shown in Fig. 4, in position. This is also made of machinery steel and is case-hardened. *G* shows the steel handle also shown in Fig. 11. *H* is a vulcanized-fiber thrust washer; this would probably be better if it were substituted by a ball race, to take the thrust of the drill. *I* shows the drill chuck, with a straight-shank twist drill in position.

Fig. 5 shows the plan, and Fig. 6 the elevation, of the steel plate for carrying the three transmission pinions, in the three tapped holes *K*, *L* and *M*, into which are screwed three case-hardened steel shoulder screws *N*. These shoulder screws are slightly riveted over at the bottom to prevent them backing out when working. Fig. 8 shows one of them in elevation. The boss on the plate *J* is a nice running fit in the hole bored through the cover, shown in Fig. 4, and is keyed on the handle *G*, Fig. 11, by threaded pins in the two small tapped holes *O O* and *S T*, which are drilled and tapped half in each. Figs. 9 and 10 show one of the three case-hardened steel pinions *P*, which are mounted on the studs *N*, and which gear with the central driven pinion *Q*, Fig. 7. The shank of *Q* passes through the hole *P* in the center of the plate *J*, in Figs. 5 and 6, and is secured to the drill chuck by the tapered seat. There is no sensitive or lever feed to this device, the ordinary feed on the drill being used as usual. In operation the handle *G* is held in the workman's hand, the case *C*, containing the internal gear *E*, drives the three pinions *P*, mounted on the plate *J*, round the central pinion *R*, which in this case has one-third the number of teeth the internal gear *E* has, thus *R* turns three times as fast as *C*. All the working parts are case-hardened and provision should be made for oiling the pinions and bearings, by drilling oil holes through the case *C*, one of which is shown at *U* for oiling the three transmission pinions. We have had two of these attachments in use four years now, and they have saved their cost many times over and reduced drill breakages considerably. They are suitable for drilling up to about ⅜ inch diameter in steel, and ½ inch in gray iron and the results are uniformly of a nature that give entire satisfaction.

Of course, the pinion *R* will rotate the opposite way to the drill spindle by introducing the pinions *P*, to transmit the power from the internal gear, so that the drilling machine is run the reverse way as if for backing out a tap, when using a drill in the speed accelerater here shown.

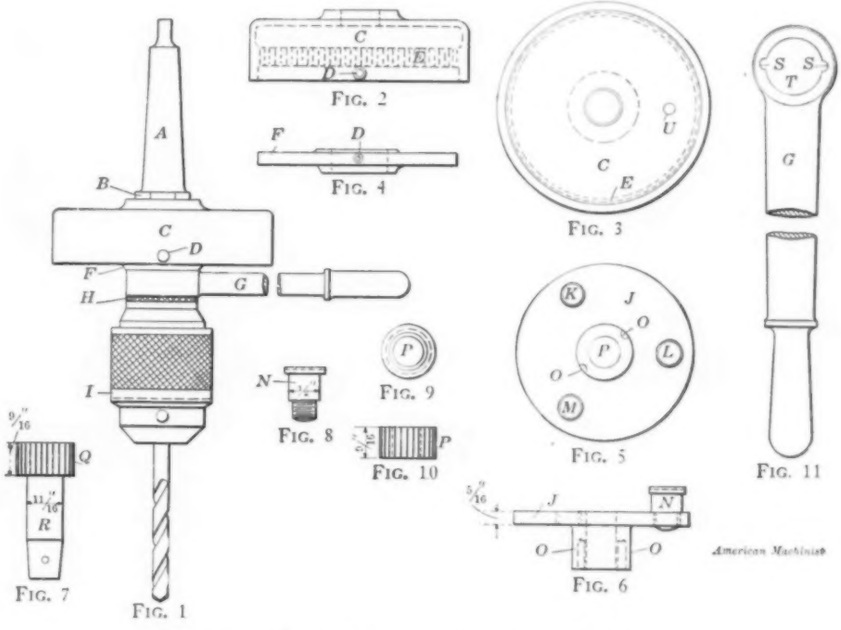

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 9. Fig. 10. Fig. 11.

HIGH-SPEED DRILLING ATTACHMENT FOR THE RADIAL

The so called "Coslettising" process for producing a rust-proof finish on iron is referred to in a recent issue of the *Brass World*. A rust-proofing process for iron and steel has recently been tried which consists in boiling the iron or steel article to be treated in a solution of 1 gallon of water, 4 ounces of phosphoric acid and 1 ounce of iron filings. By this means a black coating is produced on the iron or steel, which protects it from atmospheric and other corrosive influences. As far as the protection of the coating against corrosion is concerned, it is stated that a piece of steel treated by the process and immersed in salt water for nearly a year has resisted its attacks, so that it is practically free from corrosion, while a similar piece untreated has become badly rusted.

Automobile Engine Proportions—II

By A. G. Kessler
and G. W. Lewis

Second section of article giving proportions of automobile engines, based upon the best current practice.

Design of connecting rod for compression load of cylinder, and tension of inertia of reciprocating parts.

Shafts; diameter and length of pins and bearings, and web proportions.

Flywheel calculations and proportions.

Connecting-rod Design

A steel column is considered a long column only when its length is twenty or more times its diameter. All automobile-engine connecting rods therefore come under the head of short columns. The smallest section of such rods is consequently designed for strength against a compression loading.

It has been found from examination of numerous types of automobile-engine connecting rods, that practically all of them are made with the I-section. In a very few cases round sections, *H*-sections and even star-shaped sections are employed. These instances are, however, quite rare. In the discussion which is to follow, therefore, only those rods having the I-section will be considered.

An average section through the body of an I-shaped connecting rod is shown in Fig. 1. Out of some thirty different types of rods, over twenty-five were found to have the following values for *A*, *B*, and *C* (see Fig. 1):

$A = 3/16$ inch; $B = 1/8$ inch; $C = 3/16$ inch. These values hold for practically all sizes of automobile-engine cylinders, the strength of the rod being varied by changes in the cross-sectional area produced by changes in the values of h and b.

Area of Least Section of Connecting-rod Body

The section of least area of the connecting-rod body (near the piston-pin end of the rod) must take the maximum explosion load in direct compression.

Since the maximum explosion on the piston, and consequently on the rod, is a function of the square of the cylinder diameter, the least area of the rod body must be proportional to D^2. This was found to be so in practice, according to the following equation:

$$A_{ls} = 0.02\,D^2$$

and A_{ls} varies between $0.0145D^2$ and $0.026\,D^2$, where A_{ls} = area least section connecting-rod body, in square inches; D = cylinder diameter in inches.

Compressive Stresses on Least Section of Rod Body

In order to calculate the maximum compressive stress on the smallest section of the connecting-rod body, it is merely necessary to divide the total maximum explosion load on the piston by the area of the least section of the rod body, as follows:

$$P_c = \frac{P_m \times 0.785\,D^2}{\text{Area least section rod, sq.in.}}, \quad \text{(a)}$$

in which

P_c = Intensity of compressive stress on smallest section of rod body, in pounds per square inch;

P_m = Maximum explosion pressure in pounds per square inch;

D = Cylinder diameter in inches.

Then by making use of equation (a) and the equation for rod area found above, the intensity of compressive stress can be readily found.

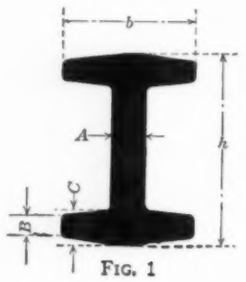

FIG. 1

FIG. 2
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Connecting-rod Proportions

From the above equations, for a maximum explosion pressure of 250 pounds,

P_c = Approximately 9800 pounds per square inch;

for a maximum explosion pressure of 300 pounds,

P_c = Approximately 11,800 pounds per square inch;

for a maximum explosion pressure of 350 pounds,

P_c = Approximately 13,800 pounds per square inch.

In all, over thirty different designs of rods were checked in this way and the minimum P_c found was about 10,000 pounds per square inch, and the maximum P_c was 19,000 pounds per square inch, all on the basis of a maximum explosion pressure of 350 pounds. The average obtained was 14,000 pounds per square inch.

Since the majority of automobile connecting rods are drop forgings, made of mild steel, with an elastic limit of approximately 40,000 pounds per square inch, the resultant approximate factors of safety are as follows:

In the average case, $40{,}000 \div 14{,}000$; 3.

Least factor of safety, $40{,}000 \div 19{,}000$; 2.

Greatest factor of safety, $40{,}000 \div 10{,}000$; 4.

Design of the Least Section

The relation between h and b, Fig. 1, is given for the average case by $h = 1.3\,b$, and this ratio varies between $h = 0.89\,b$ and $1.75\,b$.

h = Width of least section in inches, in plane of rotation.

b = Width of least section in inches, perpendicular to plane of rotation.

Having found the relation between h and b, it is next necessary to determine one of these values. From the preceding empirical formula, the area of the least section of the rod body can be determined. This area can also be expressed in the following manner:

$$A_{ls} = \left[2\,b \times \frac{B+C}{2}\right] + \left[\left(\frac{h}{b} \times b\right) - 2C\right] A$$

For meaning of symbols, see Fig. 1.

Now, the average values of A, B and C are known, as are also the area of least section in terms of the cylinder diameter and the value of h in terms of b. Then the next equation results:

$$A_{ls} = [2\,b \times \tfrac{5}{32}] + [1.3b - \tfrac{3}{8}]\,\tfrac{3}{16}.$$

Hence

$$0.3125\,b + 0.243\,b - 0.072 = A_{ls}$$

(area least section in square inches), and

$$b = \frac{A_{ls} - 0.072}{0.556} = \tfrac{9}{5}\,(A_{ls} - 0.072),$$

in inches.

Then, having found b, the average value of h can be found from $h = 1.3\,b$.

A similar equation to the one above can be worked out in the same manner, using other average values, if so desired. The values given here are the best averages, as taken from practice.

Forces Acting on Rod

The connecting rod is subjected to three kinds of stresses: (1) compression, (2) tension, (3) flexure.

The compression, which is due to the explosion of the gas in the cylinder, has been taken care of in the design of the smallest section of the rod (at the wrist-pin end), where this stress reaches its maximum value.

The tension, which is due to the suction pressure in the cylinder and to the inertia of the reciprocating parts, need not be considered in the design of the rod body, and will be properly considered in the design of the rod ends.

Flexure in the rod is due to whipping forces which increase from a minimum near the wristpin end to a maximum at some point near the crank-pin end. For this reason the rod body is given a certain amount of taper, so that it will be of practically uniform strength throughout its length.

Taper of Connecting-rod Body

This taper of the rod body is in the plane of rotation, increasing in width from the wrist, toward the crank-pin end. Perpendicular to this plane the dimension is usually kept constant throughout the entire length of the rod. h therefore changes in value while b is kept constant. See Fig. 1.

The ratio of h' to h, Fig. 2, is given for the average case by the following equation. In this equation L = stroke in inches.

$$\frac{h'}{h} = 3.3 - 0.4\ L.$$

An inspection of this equation shows that as L, the engine stroke, is increased, the ratio of h' to h becomes smaller (more nearly unity). This may at first sight look peculiar, but a mathematical study of the whipping force will show that it varies inversely as the stroke, and therefore for uniform strength the dimensions h' and h can be made more nearly alike as the stroke of the engine is increased, for a constant piston speed.

Length of Connecting Rod

The length of connecting rod is the distance between center of wrist, or piston pin, and center of crank-pin, and is given for the average case in terms of the engine stroke, by the following equation:

$$L_{co} = 2.175\ L,$$

varying between $L_{co} = 1.9\ L$ and $L_{co} = 2.615\ L$.

L_{co} = Length of connecting rod in inches;

L = Stroke in inches.

Weight of Connecting Rod

The weight of connecting rod is more nearly a function of the product $L_{co} \times D^2$ (length of connecting rod by square of cylinder diameter) than it is of the square of the cylinder diameter alone. For basis of comparison, however, equations were determined for both cases. For average conditions:

$$W_{co} = (0.0135\ L_{co}\ D^2 + 1.2)\ \textit{pounds};$$

or

$$W_{co} = (D^2 \div 5)\ \textit{pounds},$$

in which

W_{co} = Weight of connecting rod in pounds;

L_{co} = Length of connecting rod in inches;

D = Cylinder diameter in inches.

The first of the above two equations is by far the more accurate, and the second gives only approximate results.

Bolts or Studs in Crank-pin End of Connecting Rod

The crank-pin end of automobile-engine connecting rods is commonly of the marine type, the bearing cap being held to the body of the rod by either two or four bolts, or studs. The forces to which these bolts are subjected consist principally of the inertia force of the reciprocating parts and the force due to suction in the engine cylinder. The total suction pressure is, at its maximum, seldom, if ever, equal to one-tenth of the inertia force. For this reason, in the following discussion the design of bolts will be based only on stresses produced by the inertia forces, the tension due to suction pressure being neglected entirely. The discussion has been based upon a maximum piston speed of 1500 feet per minute, which will consequently give safe results, but is not far different from that often attained in practice.

Total Weight of Reciprocating Parts

Before it is possible to determine the inertia forces it is necessary that the total weight of reciprocating parts be known. The total weight of these parts was taken equal to weight of piston, plus weight of piston-pin, plus total weight of connecting rod. In come cases a part of the connecting rod weight is assumed as reciprocating and the remainder as rotating. In this discussion, however, it was considered best to use the total connecting rod weight as a reciprocating mass. This slightly increases the values of inertia forces but brings results on the safe side and partly compensates for forces which have not been considered. For average conditions:

$$W_{rp} = 4.45\ D - 10.35\ \textit{pounds},$$

in which

W_{rp} = Total weight of reciprocating parts in pounds;

D = Cylinder diameter in inches.

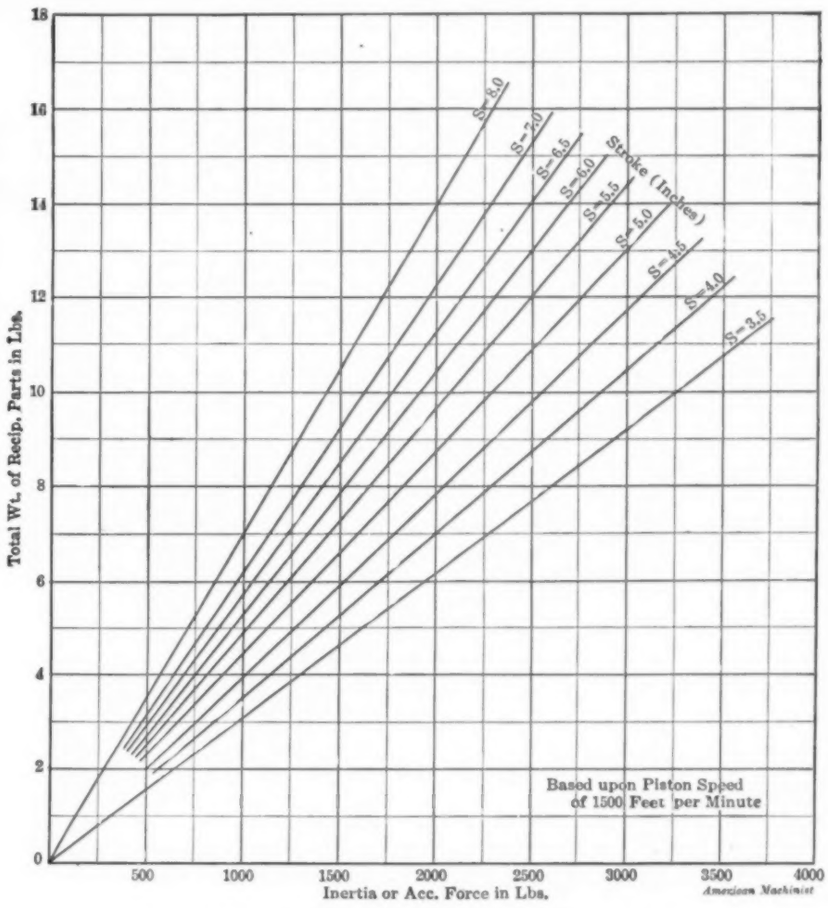


Fig. 3. Initial Inertia Force of Reciprocating Parts

Inertia Forces

It is mathematically shown in various textbooks on engine design that the in-

ertia, or accelerating force at beginning and end of stroke, is approximately equal to the centrifugal force that would be exerted by the reciprocating parts, if they were all revolving around the shaft at the diameter of the crank circle. This force is expressed by the following formulas, assuming a piston speed of 1500 feet per minute:

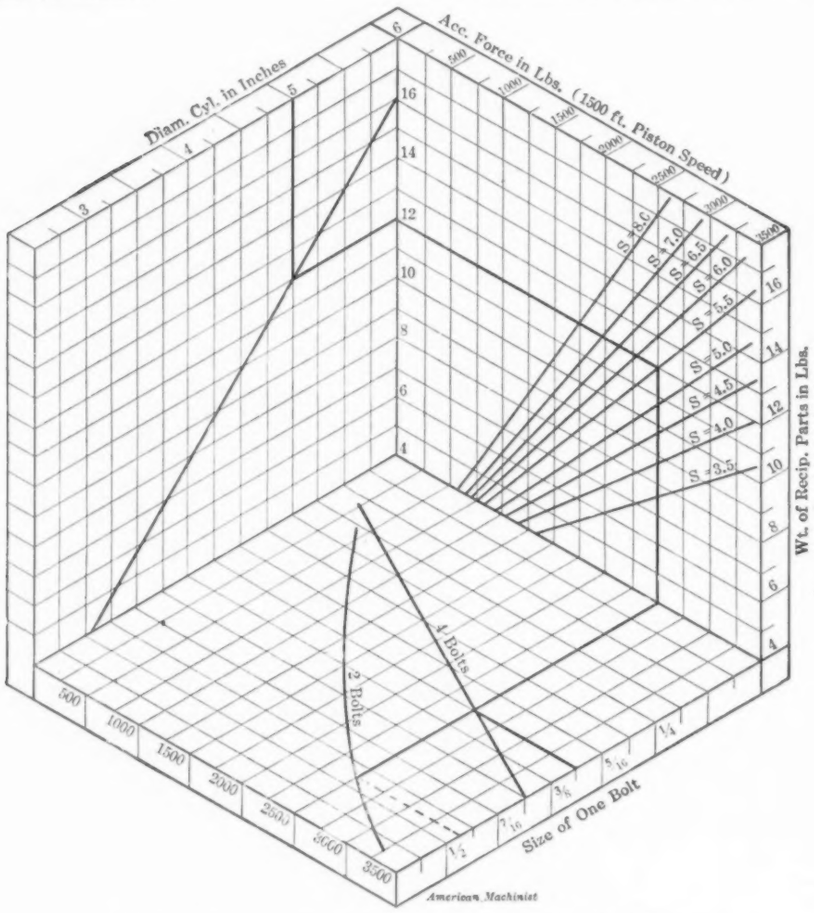


FIG. 4. BOLTS FOR CONNECTING-ROD CAP. CRANK-PIN END

Accelerating force =

$$\frac{W_{rp}}{g} \cdot \frac{2\pi^2 \times 750^2}{3600\,L},$$

and

Accelerating force =

$$W_{rp} \times \frac{95.75}{L} \text{ when } L \text{ is in feet,}$$

or

Accelerating force =

$$W_{rp} \times \frac{1150}{L} \text{ when } L \text{ is in inches.}$$

W_{rp} = Total weight of reciprocating parts in pounds.

By the aid of the above equation Fig. 3 was developed, which shows the relation between total weight of reciprocating parts and total inertia, or accelerating force, the various engine strokes ranging from 3½ to 8 inches.

BOLTS OR STUDS IN CRANK-PIN END OF CONNECTING ROD

In Fig. 4 are given results based on previous assumptions and calculations, by which, for any cylinder diameter, the average size of bolts, or studs, used in the crank end of automobile-engine connecting rods can be determined. It was found that in the average case the allowable tensile stress in these bolts was 10,000 pounds per square inch, and Fig. 4 is based on this allowable fiber stress. The method of using this figure may be readily understood by following the heavy line as per following example:

Consider the case of an engine with a 5-inch bore and 5½-inch stroke. Following the heavy line for a 5-inch cylinder diameter, the weight of reciprocating parts is found to be 12 pounds; the inertia or accelerating force is found to be approximately 2500 pounds, and the size of bolts would be:

For 4 bolts, size = ⅜ or 5/16 inch. 5/16 inch would probably be used.

For 2 bolts, size = approximately ½ inch.

Dimensions of bolts given in the figure are *actual standard bolt sizes*, and *not* diameter at root of thread.

WRISTPIN END OF CONNECTING ROD. CLOSED OR SOLID ENDS ONLY

The design of the wristpin, or piston-pin, end of the rod was attacked in a manner very similar to that of the crank-pin end. The only force considered acting on the piston-pin end of the rod was that due to inertia, the engine suction again being neglected. The inertia, or accelerating force, in this case is considerably smaller than that at the crank-pin end of the rod, being produced only by the weight of the piston and piston pin.

For the average case, the weight of piston plus weight of piston pin = W'_{rp} = 2.35 D — 5.15 pounds. Hence the accelerating, or inertia, force then becomes equal to $W'_{rp} \frac{1150}{L}$, where L = stroke in inches. This is again on the basis of a piston speed of 1500 feet per minute.

It was found from a series of calculations, that the average allowable fiber stress, on the above asumptions, in the wristpin end of connecting rods is 1900 pounds per square inch.

The area of section of the closed end does not depend entirely upon the allowable fiber stress, as the section must be large and stiff enough to allow machining and the stresses attendant thereto. Another factor which brings up the allowable fiber stress is that the bearing must be drilled to facilitate lubrication of the wrist, or piston pin. This is usually done by drilling several holes in the closed end of the rod, through which the oil from a splash system of lubrication may enter. Drilling these holes cuts out material and consequently raises the fiber stress slightly above that calculated.

On the basis of the above assumptions Fig. 5 was developed which, if followed out exactly as explained for the crank-pin end, will give the total area of section at the wristpin end of the connecting rod. This value divided by two will give the area of section of either side of the closed end. These sections are commonly made of the form shown in Fig. 6 with G = 3/16 inch and F = ⅛ inch, for practically all cylinder diameters. The area which takes the total tension at the piston-pin end of the rod, as determined from Fig. 5, should then

$$= 2H\,\frac{(\frac{1}{8} + \frac{3}{16})}{2}$$ square inches (see Fig. 6).

Wristpin ends with one side solid and the other split, having a bolt, or stud, to take up on the split side, are also very common. In this case the solid side is made slightly heavier than for plain solid ends of the same engine size. Bolts are commonly designed for a stress of 10,000 pounds per square inch, although the actual stress, a result between tension and bending, may run somewhat higher than this.

BUSHINGS FOR WRIST- AND CRANK-PIN ENDS OF CONNECTING RODS

Bushings for wrist- and crank-pin ends of connecting rods are commonly brass, or bronze sleeves of the following di-

mensions. They may be made solid, or split, as conditions require.

Bushings for wristpin end:

$D = 3\frac{1}{2}$ inches to 5 inches, thickness bushing = $\frac{1}{8}$ inch;

$D = 5$ inches to 6 inches, thickness bushing = 3/16 inch.

Bushings for crank-pin end:

$D = 3\frac{1}{2}$ inches to $4\frac{1}{2}$ inches, thickness = 3/16 inch;

$D = 4\frac{1}{2}$ inches to 6 inches, thickness = $\frac{1}{4}$ inch.

Additional Dimensions for Connecting Rods

Following are additional dimensions given elsewhere, but repeated here as they are necessary in the design of connecting rods:

Wristpin diameter:

$D_{wp} = 0.34\ D$ — 0.53 inch (average case).

Wristpin bearing length:

$L_{wp} = 2.25\ D_{wp}$ (average case);

D_{wp} = Wristpin diameter in inches;

L_{wp} = Wristpin bearing length in inches;

D = Cylinder diameter in inches.

Crank-pin diameter:

$D_{cp} = 0.238\ D + \frac{3}{4}$ inch.

Crank-pin length:

$L_{cp} = 3\ D - 11\frac{1}{4}$ inches;

D_{cp} = Diameter crank pin in inches;

L_{cp} = Length crank pin in inches;

D = Cylinder diameter in inches.

Crank Shafts for Automobile Engines

To accurately consider all types of automobile-engine crank shafts at present in use, is, of course, out of the question. It was therefore deemed best to consider the type most commonly found, namely, the *four-throw, three-bearing shaft*, with plain bearings, as Fig 7, generally used on four-cylinder, four-cycle engines. The following, therefore, applies only to the type mentioned.

Overall Length of Crank Shaft

This item is given for the average case as a function of the cylinder diameter:

$$L_{cs} = 7\ D + 6 \quad inches,$$

where

L_{cs} = Overall length crank shaft in inches;

D = Cylinder diameter in inches.

Crank-pin Diameter

Crank-pin diameters were found to vary between $1\frac{1}{4}$ inches and $2\frac{1}{4}$ inches, with an average given by

$$D_{cp} = 0.53\ D - \tfrac{5}{8}\ inch,$$

where

D_{cp} = Diameter crank pin in inches;

D = Cylinder diameter in inches.

Crank-pin Length

The determination of crank-pin length was rather unsatisfactory. What seems to the writers probably the safest and surest method for design of this part is as follows:

The diameter of the pin can be determined from the equation just given, after which the length may be made such that the maximum bearing pressure on the pin, per square inch of projected area, shall not exceed from 1200 to 1500 pounds, on the basis of maximum explosion pressures ranging from 300 to 375 pounds per square inch.

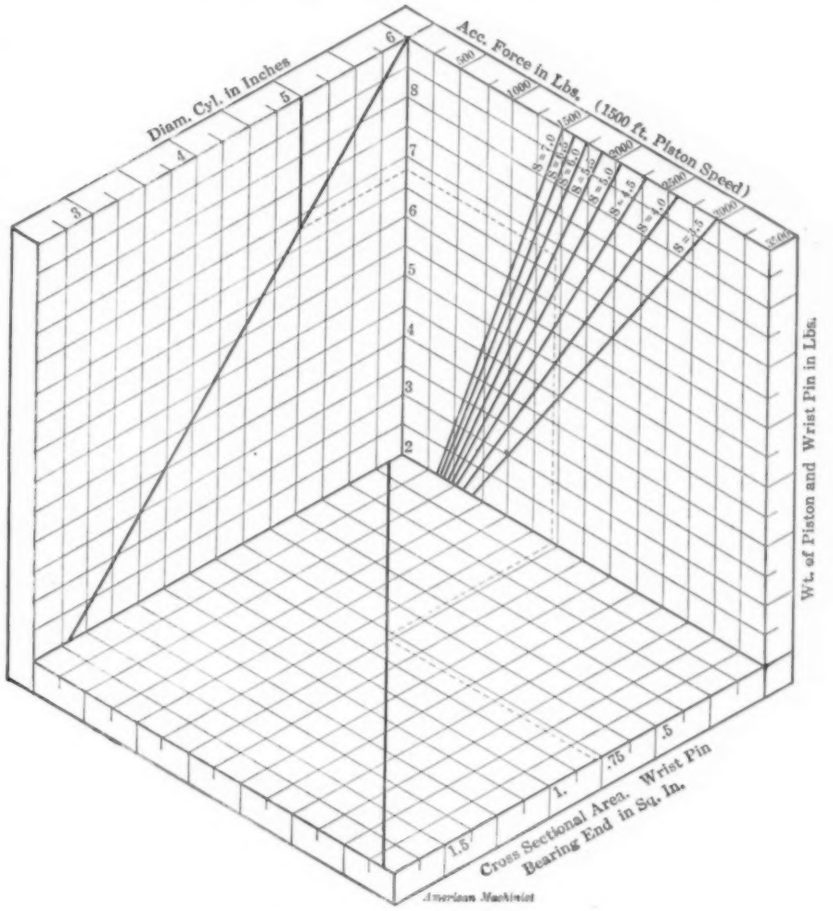

Diam. Cyl. in Inches
Acc. Force in Lbs. (1500 ft. Piston Speed)
Wt. of Piston and Wrist Pin in Lbs.
Cross Sectional Area, Wrist Pin Bearing End in Sq. In.
American Machinist

FIG. 5. AREA OF WRISTPIN-BEARING END OF CONNECTING ROD

Thickness of Crank Webs

The thickness of crank webs *a* and *c*, Fig. 7, in terms of the cylinder diameter $= T_w = 0.4\ D - 0.85$ inch, where D equals cylinder diameter in inches.

For thickness of crank web *b*, Fig. 7:

$$T_w = 0.5\ D - \tfrac{7}{8}\ inch;$$

T_w = Thickness web *b* in inches;

D = Cylinder diameter in inches.

Width of Crank Webs

Crank webs must at least be wide enough at *a* and *c*, Fig. 7, to surround the crank pin, and this value is consequently given in terms of the crank-pin diameter:

$$W_w = 0.333\ D_{cp} + 1.7\ inches,$$

where

W_w = Width of crank webs *a* and *c*, in inches;

D_{cp} = Diameter crank pin in inches.

For width of crank web *b*, Fig. 7:

$$W_w = 3.54 - \tfrac{3}{4}\ D_{cp}\ inches;$$

W_w = Width crank web *b* in inches;

D_{cp} = Diameter crank pin in inches.

This equation seems to show that, as the crank-pin diameter is increased, the web is made less in width. For small pin diameters very wide webs are used; but as the pin diameter increases, the web width decreases, until the web width is approximately equal to the pin diameter. At this point the web is generally of a cylindrical section, or very nearly so.

Dimensions of Center Bearing

Center bearings were found to vary in diameter between $1\frac{1}{2}$ inches and $2\frac{1}{8}$ inches, with the average same as for crank-pin diameters:

$$D_{cb} = 0.53\ D - \tfrac{5}{8}\ inch;$$

D_{cb} = Diameter of center bearing in inches.

For length of center bearing;

$$L_{cb} = 2.8\ D_{cb} - 2.2\ inches;$$

L_{cb} = Length of center bearing in inches;

D_{cb} = Diameter of center bearing in inches.

Dimensions of Front Bearing

In most automobile motors the flywheel is placed at the rear of the engine or on the transmission side. The flywheel or transmission side of the motor has, therefore, been called the rear, and the opposite end the front side of the motor.

For diameter of front bearing;

$$D_{fb} = 0.53\,D - \tfrac{5}{8}\ inch,$$

where

D_{fb} = Diameter of front bearing in inches.

The diameter of the front bearing was found to vary between 1½ inches and 2¼ inches.

The curves found for length of front bearing divided themselves into two separate classes, as may be seen by the following equations:

$$L_{fb} = D_{fb} + 1\tfrac{1}{8}\ inches;$$

$$L_{fb} = 1.67\,D_{fb} + 0.95\ inch,$$

where

L_{fb} = Length of front bearing in inches.

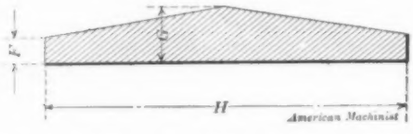


Fig. 6. Section through Half of Piston-pin Bearing of Connecting Rod

D_{fb} = Diameter of front bearing in inches;

This shows that there are two distinct types of shaft at present in use.

Dimensions of Rear Bearing

The rear bearing is, as previously stated, the one next to which the flywheel is placed. Its diameter is the same as the other bearing diameters:

$$D_{rb} = 0.53\,D - \tfrac{5}{8}\ inch,$$

where

D_{rb} = Diameter of rear bearing in inches.

The rear bearing must take care of the greater part of the forces and pressures induced by the weight of the flywheel, and hence its length is made correspondingly great.

$$L_{rb} = 5.33\,D_{rb} - 5.66\ inches,$$

where

L_{rb} = Length of rear bearing, in inches;

D_{rb} = Diameter of rear bearing, in inches.

The above completes all equations necessary for the design of four-throw, three-bearing crank shafts for all cylinder sizes used in automobile practice.

Flywheels for Automobile Engines

According to the method of determining flywheel weights for a given coefficient of fluctuation, from crank-effort diagrams, it is found that flywheels for automobile engines would weigh only a small fraction of a pound. In other words, as far as the motor alone is concerned, no wheel is required. In an automobile, however, the requirements are very different from stationary-engine practice, since the flywheel is relied upon to start the automobile itself; that is, to overcome the car's inertia.

Automobile-engine flywheels are built in a number of forms, depending upon the separate functions they are called upon to perform. There are, however, three principal types which may be designed in any number of ways to suit existing conditions. These types are:

(a) Plain flywheels;
(b) Flywheel fans;
(c) Flywheel clutches.

The following discussion applies only to flywheels for four- and six-cylinder motors. It may be considered to apply

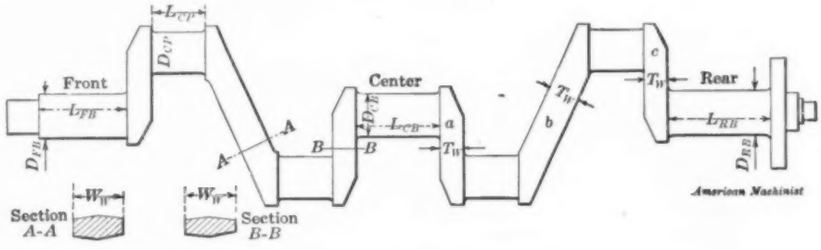


Fig. 7. Proportions of 4-throw Crank Shaft

in general to any of the types mentioned above, but particularly to the construction of plain wheels.

Outside Diameter of Flywheels

The outside diameter of flywheel is given as a function of the crank length (half stroke).

$$D_{fw} = 11.5\,R - 11.7\ inches,$$

where

D_{fw} = Outside diameter of flywheel, in inches;

R = Crank length (half stroke), in inches.

Flywheels as used at present range from 12 to 21 inches in diameter, and the above equation holds good, therefore, only between those limits.

Center of Gravity of Wheel-rim Section

From an examination of some thirty types of flywheel designs, the rim depth was found to vary between ¾ inch and 2 inches, with an average for all sizes of 1⅜ inches. Therefore, the diameter out to the center of gravity of the wheel-rim cross-section = D_{rcg}, may be taken = D_{fw} − 1⅜ inches. D_{fw} = outside diameter of flywheel in inches.

Flywheel Weight

On account of the peculiar conditions in the determination of flywheel weights for automobile motors, certain assumptions were necessary, of which the following is an important one. The diameter out to the center of gravity of the wheel *rim* cross-section was used instead of the diameter out to the center of gravity of the whole wheel. This was necessary on account of the many ways in which wheels are built, and the impossibility of determining, even approximately, the desired quantity.

The inertia, or flywheel effect exerted by the wheel rim may be taken as a function of the product: *wheel weight by square of diameter to center of gravity of rim section.* This product may also be considered to vary with the power of the motor, and may consequently be taken proportional to the square of the cylinder diameter. Therefore the following equation was determined:

$$W_{fw} = \frac{1920\,D^2 - 13{,}900}{D_{rcg}^2},$$

where

W_{fw} = Total weight of flywheel in pounds;

D_{rcg} = Diameter to center of gravity of rim section in inches;

D = Cylinder diameter in inches.

Area of Rim Section of Flywheel

For the average case, the area of rim section was determined as a function of the product ($W_{fw} \times D_{rcg}^2$); *weight of wheel (total) by square of diameter to center of gravity of rim section.*

$$A_{rs} = 0.0001875 \times W_{fw} \times D_{rcg}^2 + 0.82\ square\ inch.$$

A_{rs} = Area rim section in square inches;

W_{fw} = Total weight of wheel in pounds;

D_{rcg} = Diameter to center of gravity of rim section, in inches.

The dimensions of the rim section vary according to the type of wheel desired. The width of wheel face may be anything from 2 to 6 inches, but generally lies between 3 inches and 4½ inches. The depth of rim, as stated before, varies between ¾ inch and 2 inches, with an average of approximately 1⅜ inches.

TYPE EXAMPLE

The following type example is worked out on the basis of the equations and data just given:

Assume a four-cylinder motor with a bore of 4½ inches and a stroke of 5 inches.

Crank length, therefore = 2½ inches.

Outside diameter flywheel (from previous equation) = 17 inches.

Diameter to center of gravity of rim section = 17 inches — 1⅜ inches = 15⅝ inches.

Weight of wheel (total) × square of diameter to center of gravity of rim section, $W_{fw} \times D_{rcg}^2 = 24{,}400$.

Then, dividing by D_{rcg}^2 gives 24,400 ÷ 245 = approximately 100 pounds for total weight of flywheel.

The area of rim section (from previous equation) then becomes equal to 5.4 square inches, which may be divided into rim width and thickness as desired.

From the above, the weight of metal in the rim was calculated and found to be equal to 69.5 pounds. In other words the rim holds approximately 69.5 per cent. of the total weight of the flywheel, the rest of the weight being made up in spokes and hub.

Machining Vulcanized Fiber

By J. Ellison

The practice of a British shop making fiber brake shoes for bicycles; sawing, milling and punching operations.

Figs. 1 and 2 show the side and end views of a vulcanizing fiber brake block. The first operation is to saw the material into strips with a 12-inch circular saw. This operation calls for no special mention, except that the saw teeth should be rather finer pitched than for wood. We found from 3/16 to ¼ inch give the best results. The teeth should be "set" just the same as for sawing wood, and a small amount of oil put on the saw occasionally makes it run sweeter. I have seen slitting saws tried for this operation, same as used for sawing metal on the milling machine, but with no success.

After they are sawn into lengths, the next operation is to cut the dovetails in, or bevel the edges, to secure them in the shoes. There are various ways of performing this operation, and after investigating the various claims of each method we decided to have a vertical-spindle attachment to the saw bench with a fly cutter, as shown in Fig. 3.

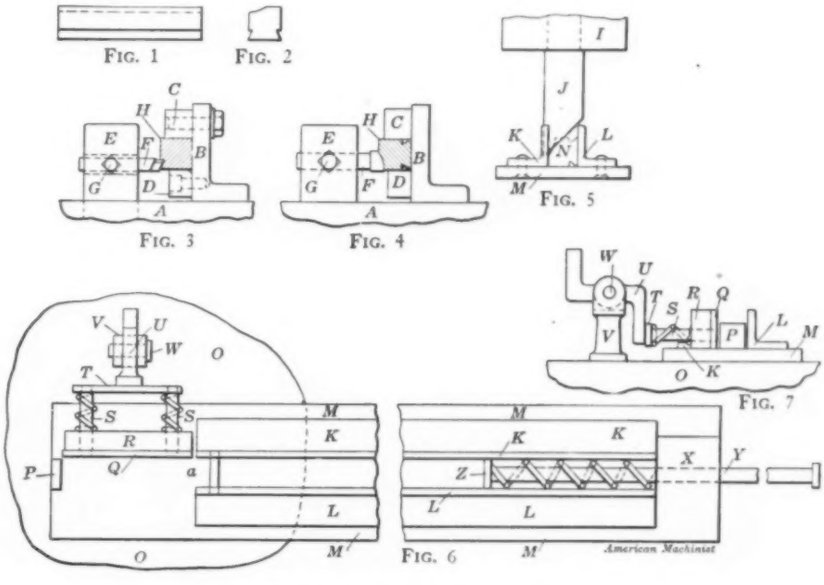
A represents the saw-bench table, and *B* the fence, *C* and *D* are two small adjustable strips secured to it by setscrews, as shown, and form a guide passing the strips *H* through. *E* is the vertical spindle driven at 2000 revolutions per minute. *F* is a common fly cutter filed to shape, out of square tool steel, and secured in the spindle by the setscrew *G*. After one side has been machined the strip is reversed and the opposite side completed. This method undoubtedly makes a much better and smoother job than any method of sawing or milling I have yet seen, and at the same time completes them with a high degree of accuracy in record time.

After the beveled edges are complete to size, the top requires machining to shape, to suit the rim it is to act on. A common contour is shown at Fig. 2. To produce this outline we substitute the fly cutter shown in Fig. 3, with the one shown in Fig. 4, and turn the strips *H* one-quarter way around, and proceed exactly as in the last operation. This completes the operations as far as the saw bench is concerned in this case. The strips are now ready to be cut off to length to complete them. A common way to do this is to saw them off with a circular saw, using a stop for length. This method produces a jagged end, and occasionally makes the blocks difficult to insert in the brake shoes, so after some experimenting we decided to do them on the power press.

Fig. 7 is a plan view and Fig. 8 shows an end elevation, while Fig. 5 shows an end elevation of the knife, work and strip guide.

Referring to Fig. 5, *I* shows the bottom of the press ram, and *J* the sharp parting or cutting-off tool, which very much resembles a joiner's chisel, but ground with a beveled cutting edge. *K* and *L* are two small angles, riveted to the long, gray-iron strips *M*, also shown in plan in Fig. 6.

The work is represented at *N*, Fig. 5. *O* indicates a portion of the press table, and *P* a stop, secured to *M*, which acts as a length gage. *Q* is a steel strip which acts as an ejector, and throws the severed blocks clear for the next one to come up against the stop *P*. *R* is a steel block secured on *M*, through which the two steel guide pins *S S* pass, and are riveted or screwed into *Q*. Two coil springs are put on these springs as shown, and riveted into the distance piece *T*, at the back end. *U* is a steel cranked lever supported by a small steel pillar *V*, secured to the press table, and bored out to receive the fulcrum pin *W*. *X* is a guide block, bored or drilled for the plunger rod *Y*, which carries a long, quick-wound spiral spring as shown, one end coming against the guide block *X*, and the other controlled by the plunger plate *Z*. In Fig. 6, *A* is a small pin which carries a roller, to prevent the work *N* being lifted up on the return stroke of the press; it may be said to perform



MACHINING VULCANIZED FIBER

the operation of a stripper. The strips of fiber are inserted in the channel between the two surfaces, *K* and *L*, the rod *Y* being pulled back for that purpose by the knob on the end, the spring then forces it up against the stop *P*, and the knife *J* severs a block at each working stroke, the ram of the press strikes the lever *U*, as indicated by the arrow in Fig. 7; this gives motion to the ejector *Q*, and forces the severed block clear from the path of the fiber strip, which feeds forward automatically at each stroke.

This method is very much quicker than sawing, and makes a much better job.

Machine Molding of Press Body

By I. W. Chubb

Details of the operations necessary to mold press frame on a universal molding machine. A concrete ramming block that is made in a molding flask and successfully used in ramming up the mold. Also the method employed in making it. The swinging of the flasks from the machine and making of the cope on a different machine.

The universal molding machines supplied by Bonvillain & E. Ronceray, Paris, have formed the subject of more than one article in these columns. The views here given illustrate the process employed for making press-frame molds with the R. 3 swinging universal machine. The type of frame can be seen in Fig. 1 and hardly calls for description. This illustration is somewhat out of true order in the scheme.

It will be recalled that usually, in these hydraulic swinging machines, the mold is rammed under pressure, the machine turned round on a trunnion, and as the ramming cylinder exhausts, the drawing of the mold is helped by the opposite piston, up to a certain point. After this the ramming piston continues to lower till the mold is fully withdrawn from the pattern plate. Then the action is automatically stopped, the head itself is turned away and the mold is removed.

Concrete Ramming Block

Returning to the press-frame mold, this is made in two flasks, which are a drag and what is regarded as a middle or cheek, though there is no third molding box. First the pattern plate is filled with sand, and loose pieces, such as 1, 2, 3 in Fig. 2, are put in position. Each of these is in halves so as to allow for drawing without injury to the sand.

Sand is tucked round the loose pieces and then ramming is effected with special concrete blocks. These are marked "Faux plateau" in Fig. 3 and have the shape of the under side of *E* (Fig. 4), being in fact rather like the middle or cheek in Fig. 1. This block has holes corresponding with projecting parts of the pattern plate, so as to pass the loose pieces without breaking them.

This concrete block is obtained by pouring the concrete into an ordinary molding flask, located on the machine, after the pattern plates are finished (see Fig. 4). This view shows the machine open, the cheek having been rammed and the loose pieces *E* in position. The thickness of the block is specially arranged to suit the position of the ramming piston (see Fig. 3) when it reaches its stop.

Properly made, this block does most of the ramming of the cheek, giving the impression, except opposite the projecting parts, of the under pattern plate, where holes with the necessary clearance are provided. These parts are finished with ordinary ramming, very little work being needed.

For convenience the block itself is generally hung from a trolley, not illustrated, above the machine. The part *E* (Fig. 4), being placed in the impression, leaves a little hand work, which finishes the process round the parting on this part of the mold.

The Drag

Parting sand is then put on the cheek parting and the flask for the drag is put in position on the pattern plate. The bottom board being placed on the mold-

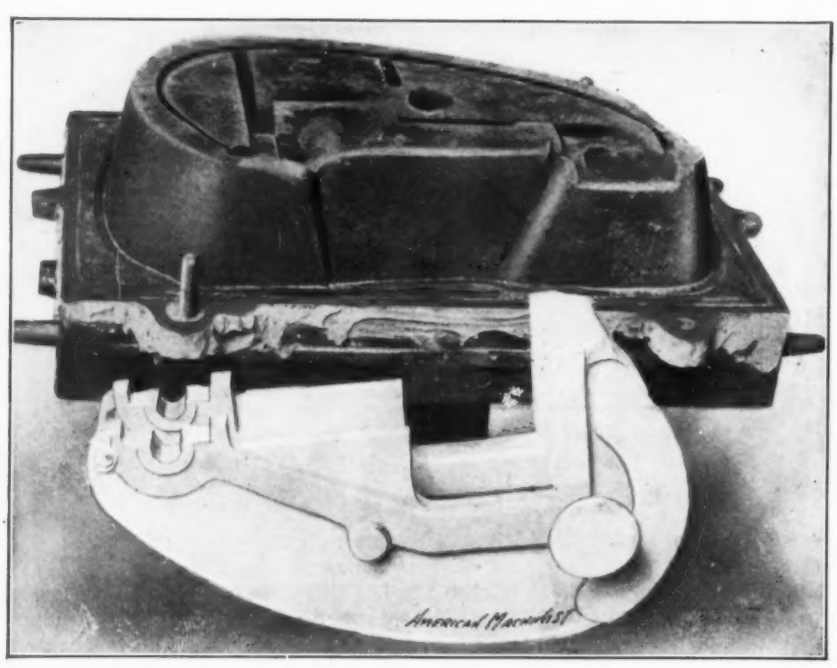


Fig. 1. Press Frames and Cheek of Mold

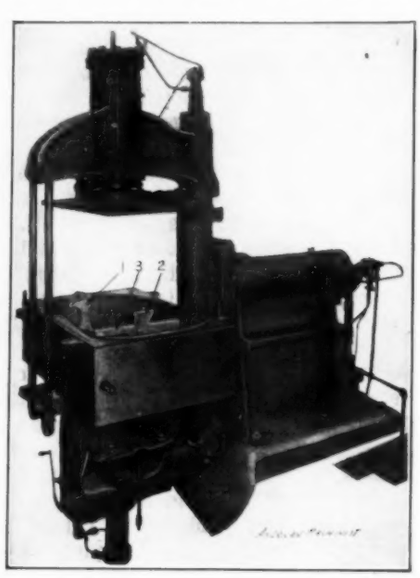


Fig. 2. Loose Piece in Mold

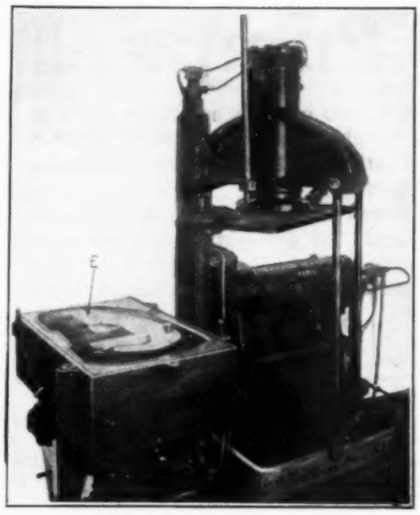


FIG. 4. MACHINE OPEN WITH LOOSE PIECE IN POSITION

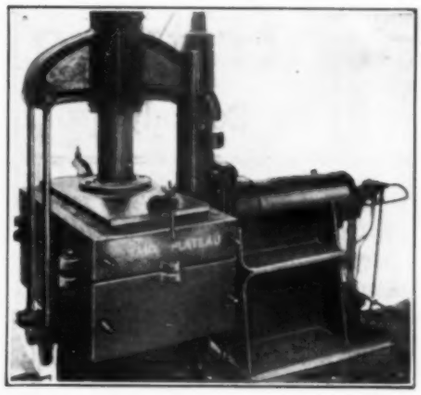


FIG. 3. CONCRETE RAMMING BLOCK

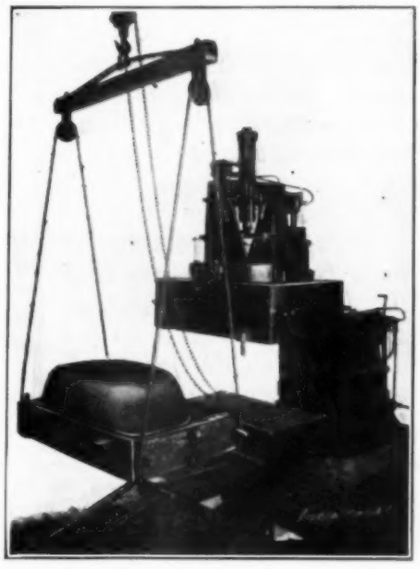


FIG. 5. SWINGING THE FLASK FROM THE MACHINE

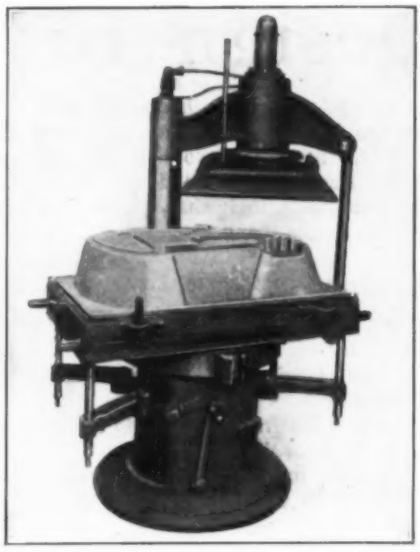


FIG. 6. MOLDING COPE SIDE

ing box, the ramming is done as usual, except that three or four pieces of sheet iron about ⅛ inch thick are placed across the board, to prevent any effect of spring in the machine.

When the ramming is completed, the piston is raised, the sheet-iron strips are taken out and the piston is lowered to its stop. There should then be very little play between the ramming block and the bottom board.

After this the hooks are turned into position to take the top flask, the nuts being somewhat tightened.

The mold can then be raised and swung aside and the piece *E* (Fig. 4), removed. To help in this, steel rods from ⅛ to ¼ inch in diameter pass through brass tubes that are bedded in the white metal of the lower pattern plate, and bolted to the lifting table of the machine.

REMOVING FLASK

Pressure being applied, the piece *E* is lifted by means of the rods, as stated, and when it is taken away the rods drop into position again. The pressing plate and mold are swung into position and then lowered and on account of the very slight play left between the pressing plate and the bottom board, the drag is not crushed. The machine is then swung right over (see Fig. 5) and the bolts that serve as hooks to hold the flask are removed, the ramming piston is put to the exhaust, and the entire mold is drawn out.

To remove the drag and cheek (see Fig. 1) from the machine, bars are placed under the bottom board as in Fig. 5, and the whole is raised with an ordinary hoist, much as illustrated.

The cope side is made in the ordinary way in an A 3 machine, Fig. 6 illustrating it with the pattern plate. The molding boxes have four pins and must be interchangeable. This is managed cheaply by using babbitt with a jig that can be readily devised.

Compound for Briquetting Borings

Recently there appeared in these columns an article on the briquetting of borings and chips, and the extent to which this process has been carried in Germany.

The S. Obermayer Company, Cincinnati, O., is now placing on the market a compound for this purpose, and reports that the best results can be obtained by the use of a box taper mold of ordinary boards, size 12x6 at the bottom, 13x7 at the top. This will make a blocking weighing from 50 to 55 pounds. The taper mold is preferred which enables the block to come out of the mold more easily.

The material may then be compressed with a small hydraulic or molding machine, using air or hand press, and the material may be compressed reasonably hard without any serious objections. This material can be rammed by hand equally as well.

In order to get the best results, use 50 pounds of briquetting compound to one ton of borings, which are mixed thoroughly in a dry state. It is well then to add sufficient water to temper this mixture, about the same that you would to an ordinary core-sand mixture.

These blocks should then be placed in a temperature of approximately 75 to 80 degrees and permitted to remain in this state for about 48 hours, when the briquets will be ready for use, to be dropped into the cupola and to be used as pig iron.

It is suggested, when charging these briquets, of cast-iron borings, not to use them on the bed of the cupola, but in any of the charges following, in which case the iron is placed in the cupola in the usual manner, then the quantity of scrap desired, and then the quantity of borings, after which the coke is added.

It is reported from experience that 10 to 15 per cent. of borings may be used to each charge in the cupola and that the results obtained with such a proportion have been very satisfactory.

Design of Centrifugal Pumps—II

By A. Borsody*

The principal losses in centrifugal pumps are well recognized, and by careful analysis they can be separated and the design regulated so as to produce the highest efficiency.

For high heads, requiring high peripheral speeds, a diffusion ring is employed, constituting a turbine pump. The diffusion ring contains passages which split up the water from the impeller into streams, gradually transforming its velocity into pressure and reducing the whirlpool losses in the casing.

A special construction described for surrounding the impeller with air, instead of water, so as to cut down the side friction, which is one of the principal losses in a centrifugal pump.

*Manager of Centrifugal Pump Specialty and Engineering Company, New York City.

The first portion of this article dealt with the design of the centrifugal-pump impeller, with relation to the characteristics. This portion will deal with the losses occurring, their analysis and steps taken to reduce them.

Losses in Centrifugal Pumps

The principal losses in centrifugal pumps are:

1. Side friction of impellers—called the rotor friction.
2. Hydraulic friction losses in the stationary parts of the pump.
3. Losses in the whirlpool chamber and losses at the periphery of the impeller.

Side or Rotor Friction

By rotor friction is meant the friction on the outsides of the impeller resulting from its rotation in practically stationary water which surrounds it. The rotor friction depends upon the tangential velocity of the impeller and upon the areas exposed to friction. In the accompanying Table 2 are given the friction losses in horsepower on the sides of impellers of various diameters operating at various peripheral speeds. The results shown are taken from actual tests performed in Germany by running disks of various diameters at different speeds in water and measuring the power consumed over that required to rotate the disks in air at the same speeds. The results have been checked by different investigators and are found to be practically correct. An impeller, as far as friction on its sides is concerned, is nothing but a disk, and therefore the results shown apply equally well to impellers.

For heads of 30, 100, 200 and 500 feet, respectively, on one single impeller, the peripheral speeds shown in Table 3 are required, and at the shown rotative speeds the side, or rotor, friction losses will be as there given.

Comparing the peripheral speed u with the rotor friction, it will be seen that:

The rotor friction varies approximately as the cube of the tangential velocity at the periphery (u), the diameter and consequently the friction areas remaining constant.

Instead of increasing the rotative speed to obtain the different heads shown, the same result can be accomplished by keeping the rotative speed constant and increasing the diameter of the impeller. The results then will be as shown in Table 4.

Diameter Impeller.	Head in Feet.	Peripheral Speed u = Feet per Second.	R.P.M.	Rotor Friction in Horsepower.
12″	30	45	860	0.51
12″	100	85	1620	3.38
12″	200	120	2280	9.61
12″	500	175	3350	27.30

TABLE 3. RELATION OF ROTOR FRICTION TO PERIPHERAL SPEED WITH CONSTANT DIAMETER IMPELLER.

Diameter Impeller.	Head in Feet.	Peripheral Speed u = Feet per Second.	R.P.M.	Rotor Friction in Horsepower.
12″	30	45	860	0.51
22½″	100	85	860	11.60
32″	200	120	860	68.00
45½″	500	175	860	400.00

TABLE 4. RELATION OF ROTOR FRICTION TO PERIPHERAL SPEED, WITH INCREASING IMPELLER DIAMETERS.

Comparing the rotor frictions in Table 4 with those in Table 3, at the same peripheral speeds, it will be seen that:

The rotor friction varies directly as the friction areas or varies directly as the square of the diameter, the peripheral speed remaining constant.

Velocity in Feet per Second.	Impeller Diameter in Inches.											
	5″	8″	10″	12″	15″	20″	25″	30″	40″	50″	70″	100″
10	0.00098	0.00249	0.00392	0.0058	0.0088	0.0153	0.024	0.0352	0.0625	0.0975	0.192	0.39
15	0.0023	0.0059	0.0092	0.0132	0.0205	0.0369	0.0578	0.083	0.147	0.228	0.452	0.92
20	0.0079	0.0201	0.0316	0.0452	0.0709	0.127	0.196	0.28	0.50	0.771	1.53	3.11
25	0.0151	0.038	0.0602	0.086	0.136	0.24	0.378	0.545	0.97	1.51	2.98	6.07
30	0.026	0.066	0.104	0.149	0.234	0.416	0.65	0.935	1.66	2.6	5.1	10.4
35	0.036	0.107	0.168	0.242	0.378	0.671	1.05	1.52	2.68	4.25	8.29	16.8
40	0.062	0.159	0.25	0.358	0.56	1.00	1.56	2.25	4.00	6.31	12.3	25.0
45	0.088	0.223	0.354	0.51	0.795	1.42	2.22	3.2	5.7	9.0	17.4	35.3
50	0.121	0.309	0.485	0.695	1.09	1.93	3.02	4.35	7.75	12.2	23.7	48.2
55	0.164	0.42	0.658	0.942	1.47	2.62	4.12	5.9	10.5	16.6	32.4	65.5
60	0.208	0.53	0.832	1.2	1.86	3.33	5.2	7.50	13.3	21.6	40.8	83.0
65	0.266	0.68	1.06	1.53	2.41	4.26	6.68	9.30	17.1	27.2	52.5	108.0
70	0.332	0.84	1.32	1.91	2.98	5.31	8.32	12.0	21.3	33.8	65.3	132.5
75	0.406	1.03	1.63	2.34	3.65	6.5	10.2	14.7	26.0	41.2	80.0	162.0
80	0.456	1.26	1.96	2.83	4.43	7.9	12.3	17.8	31.6	50.1	97.0	197.0
85	0.589	1.50	2.36	3.38	5.3	9.45	14.7	21.4	37.8	60.0	126.0	235.0
90	0.690	1.74	2.77	3.96	6.2	11.05	17.3	25.0	42.2	71.0	136.0	276.0
95	0.820	2.09	3.28	4.72	7.3	13.2	20.7	29.8	52.8	84.8	162.0	330.0
100	0.965	2.46	3.85	5.52	8.7	15.4	24.2	34.9	64.0	99.0	190.0	385.0
110	1.29	3.29	5.18	7.42	11.8	20.7	32.4	46.6	83.0	133.0	254.0	518.0
120	1.68	4.26	6.70	9.61	15.0	26.7	42.0	60.4	107.0	172.0	330.0	670.0
130	2.12	5.30	8.5	12.2	19.0	34.0	53.2	76.5	136.0	217.0	415.0	848.0
140	2.64	6.72	10.5	15.1	23.7	42.2	66.0	95.0	169.0	271.0	518.0	1050.0
150	3.24	8.28	12.0	18.6	29.5	52.0	81.1	117.0	208.0	3320.0	638.0	129.0
160	3.92	10.0	15.7	22.5	35.2	62.8	98.1	142.0	252.0	404.0	770.0	157.0
170	4.75	12.1	19.0	27.3	42.7	76.0	129.0	172.0	305.0	4890.0	935.0	1900.0

TABLE 2. SIDE-WHEEL FRICTION FOR DIFFERENT DIAMETERS AND VELOCITIES IN HORSEPOWER.

By using the above stated relations between the rotor friction and peripheral speeds and friction areas, the rotor frictions for diameters and speeds not given in the table can be obtained by interpolation.

The rotor friction depends only upon the tangential velocity and friction areas. It is independent of the pressure on the sides of the impeller.

This has been proved experimentally and is clearly shown by the curves in Figs. 10 and 11. These tests were made

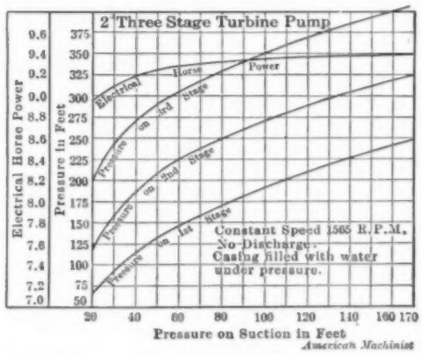


FIG. 10. CURVES SHOWING SIDE FRICTION INDEPENDENT OF WATER PRESSURE

on a two-inch three-stage turbine pump. The pump casing contained only the impellers, and was filled with water from an outside source; there was no discharge. It is seen that at constant speed and with pressures on the suction varying from 20 to 180 feet, the electrical horsepower consumed was practically constant, showing that the rotor friction remained constant under the increasing pressures. With a constant pressure on the suction,

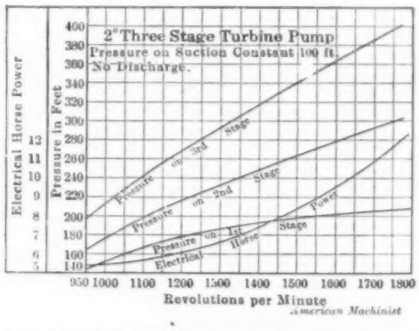


FIG. 11. CURVES SHOWING SIDE FRICTION VARYING WITH ROTATIVE SPEED

but the speed varying from 950 to 1800 revolutions per minute, the electrical horsepower consumed increased very rapidly, showing that the rotor friction increased rapidly with the speed.

Comparing the rotor-friction losses in Tables 3 and 4 for the same heads, it is seen that it is less in a smaller impeller operating at a higher rotative speed than in a larger impeller at a lower rotative speed. As rotor friction is one of the principal losses in a centrifugal pump, it is obvious that high rotative speed pumps will be more efficient than the low rotative speed pumps operating against the same head. Furthermore, at high speeds the pumps become smaller and consequently cheaper.

2. FRICTION LOSSES IN STATIONARY PARTS OF PUMP

This is a pure hydraulic-friction loss due to the passage of a certain quantity of water through the interior, stationary parts of the pump. This friction loss can

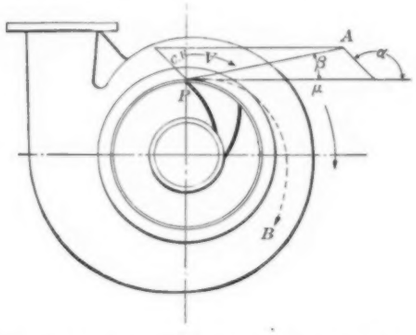


FIG. 13. ACTION OF WHIRLPOOL CHAMBER

be made, comparatively, very small by making the water passages as direct as possible and of such size as not to produce a velocity of over 10 to 12 feet per second, depending upon working conditions as explained heretofore.

3. LOSSES IN WHIRLPOOL CHAMBER AND LOSSES AT THE PERIPHERY OF THE IMPELLER

R.P.M.	Total Head in Feet.	Gallons per Minute.	Water Horsepower.	Brake Horsepower.	Total Loss, B.H.P.—W.H.P.	Efficiency.
925	72.3	800	14.6	26.7	12.1	54.9
925	71.3	850	15.3	26.9	11.6	56.9
925	70.3	900	16.0	27.5	11.5	58.1
925	68.5	950	16.5	27.9	11.4	59.0
925	66.5	1000	16.8	28.3	11.5	59.9
925	64.7	1050	17.2	29.0	11.8	59.2
925	63.4	1100	17.6	29.5	11.9	59.9
925	62.1	1150	18.05	30.2	12.15	60.0
925	85.5	0	0	11.0	11.00	0

TABLE 5. TEST OF 6-INCH VOLUTE PUMP SHOWING THAT TOTAL LOSS IS PRACTICALLY CONSTANT WITHIN CERTAIN LIMITS, AT CONSTANT SPEED.

The brake horsepower is the actual power delivered to the pump shaft. The water horsepower is the power required to raise a certain quantity of water to a certain hight. The difference, therefore, represents the total loss in the pump.

From the test given in Table 5 it is seen that the total loss, when operating at a constant speed, is practically constant between certain limits of capacity. Up to 1150 gallons per minute the total loss is practically constant and equal to 11.5 horsepower. At 1150 gallons per minute the total loss increases to 12.15 horsepower. At this capacity the water velocity in the casing is 13.4 feet per second. Generally it is found that up to about 12 feet per second the total loss will be practically constant at a constant speed. But when the water velocity exceeds this amount, the friction in the casing increases so rapidly that the total loss will increase in a greater ratio than the water horsepower, and the efficiency will drop off. Up to this point, however, the total loss remaining constant while the water horsepower increases, the effi-

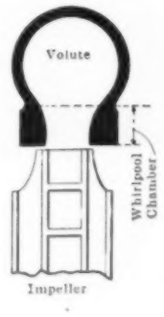


FIG. 14. SHORT EFFICIENT WHIRLPOOL CHAMBER

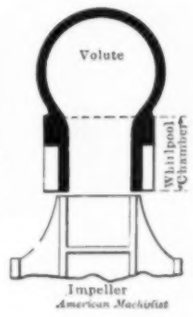


FIG. 15. LONG INEFFICIENT WHIRLPOOL CHAMBER

ciency will gradually increase. This is clearly shown in the curve, Fig. 12, which shows the efficiency curve of a 10-inch three-stage turbine pump.

The efficiency up to 2000 gallons per minute increases and after this capacity it decreases.

At no discharge, the total loss in the test given in Table 5 is 11 horsepower. As no water is discharged, the friction

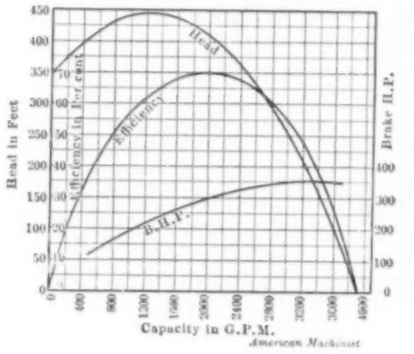


FIG. 12. CHARACTERISTICS OF 10-INCH THREE-STAGE TURBINE PUMP

loss in the casing is equal to zero. Neglecting the bearing and bushing-ring losses, 11 horsepower represents the rotor friction, plus the losses at the periphery of the impeller and losses in the whirlpool chamber. The impeller in this test was 18 inches diameter and at 925 revolutions per minute the rotor friction amounts to approximately 5 horsepower. The peripheral and whirlpool chamber losses, therefore, amount to approximately $11 - 5 = 6$ horsepower.

The whirlpool chamber in a volute pump is the chamber between the periphery of the impeller and the volute casing proper. The usually accepted theory of the whirlpool is that it gradually reduces the velocity of the water, as it leaves the impeller, to the velocity in the casing proper. The velocity in the casing is constant and usually equal to about 10 feet per second. The velocity of the water leaving the impeller is greater, say about 60 feet per second. A particle of water leaving the impeller must, therefore, greatly decrease its velocity before it can reach the casing proper. This reduction takes place in the whirlpool chamber. Therefore in the whirlpool chamber, particles of water travel at different speeds, faster near the impeller and slower near the casing. A particle of water thrown out of the impeller, if unretarded, would take the natural course *PA*, Fig. 13. But owing to the reduced velocities, it is retarded by the adjacent

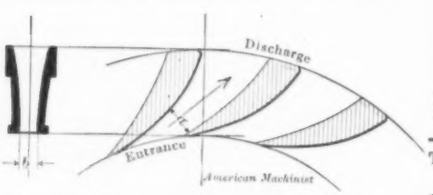


FIG. 16. DIFFUSION VANES OF TURBINE PUMP

particle nearer the casing, with the result that it will be forced to take the whirling course represented by *PB*. The different velocities and the whirling action in the whirlpool chamber cause quite a considerable loss. It has been found by experiment that the losses are less in a short whirlpool chamber, Fig. 14, than in a longer one, Fig. 15.

PERIPHERAL LOSSES IN A TURBINE PUMP. USE OF DIFFUSION RINGS

In a high-head centrifugal pump, on account of the high tangential velocity required, the losses due to the whirling action of the water in the casing become so great that it greatly impairs the efficiency of the pump. In order to eliminate this loss, diffusion rings, or diffusors, are employed, which are stationary guide wheels placed immediately around the impeller, Fig. 16. These rings serve to prevent the water from turning around in the casing, by splitting it up into a number of independent streams and discharging them radially, out into an annular casing.

The water passages in diffusion rings are so constructed that the total discharge areas are about equal to the area of the pump discharge. The total entrance areas are equal to about one-half of this. A particle of water leaving the impeller at, say, 60 feet per second, the instant it hits the blade of the diffusion ring will have its velocity reduced to $\frac{Q}{A}$, or say about 20 feet per second. Q = quantity discharged per second, and A = cross-sectional area of the water passage in the diffusion ring, at the entrance.

In the diffusion ring itself there will be a gradual reduction of velocity from 20 feet to about 10 feet per second at the discharge. If the angles of the diffusor blades are properly selected, there will be very little loss due to shock, none whatever due to whirling action, and the kinetic or velocity energy in the water will be transformed into potential energy or pressure by means of the diffusion rings.

R.P.M.	Total Head in Feet.	Gallons per Minute.	Water Horsepower.	Brake Horsepower.	Total Loss, B.H.P.—W.H.P.	Efficiency.
630	21.0	1000	5.32	9.87	4.55	54.1
680	28.0	1000	7.08	12.30	5.22	57.5
710	33.0	1000	8.33	13.80	5.47	60.3
735	35.5	1000	9.00	15.55	6.55	57.5
780	42.0	1000	10.60	17.40	6.80	60.2
815	48.0	1000	12.10	19.75	7.65	61.8
860	55.5	1000	14.05	23.25	9.20	60.5
910	64.0	1000	16.15	26.70	10.55	60.5
945	69.0	1000	17.45	29.10	11.65	60.2
975	76.0	1000	19.20	31.40	12.20	61.3
1025	86.0	1000	21.80	35.40	13.60	61.4
1070	94.0	1000	23.80	39.40	15.60	60.2

TABLE 6. TEST OF 6-INCH CENTRIFUGAL VOLUTE PUMP.

Table 6 shows a test made on the same pump as that shown in Table 5, but instead of keeping the speed constant, in this test the speed was varied and the capacity kept constant. It is then seen that the total loss increases with the revolutions per minute and therefore with the peripheral speed of the impeller (u).

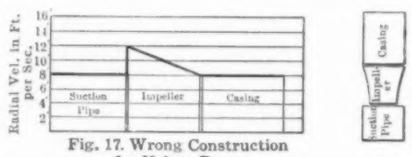


Fig. 17. Wrong Construction for Volute Pump

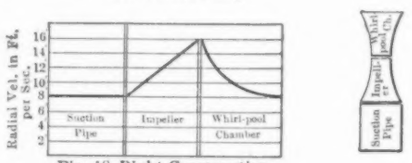


Fig. 18. Right Construction for Volute Pump

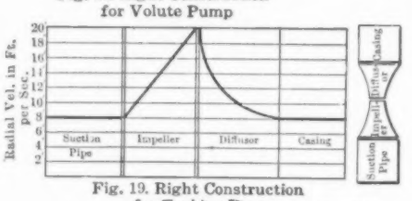


Fig. 19. Right Construction for Turbine Pump *American Machinist*

The capacity being constant, the internal losses due to hydraulic friction, etc., are constant. Assuming that this internal hydraulic friction in the casing will cause a loss of about four feet head when discharging 1000 gallons per minute, this loss will be approximately equal to one horsepower.

The diameter of the impeller in the pump is 18 inches, and knowing the speed, the rotor friction can be obtained from Table 2. The total loss practically consists of the internal hydraulic losses, rotor friction, and the whirlpool losses, so that the total loss can be segregated into these three losses as shown in Table 7.

R.P.M.	Per Speed (4).	Gallons per Minute.	Total Loss.	Internal Hydraulic, Losses.	Rotor Friction.	Whirlpool Losses.
			H.P.	H.P., estimated.	H.P.	H.P.
630	49.5	1000	4.55	1.0	1.84	1.71
680	53.4	1000	5.22	1.0	2.05	2.17
710	55.8	1000	5.47	1.0	2.22	2.25
735	57.8	1000	6.55	1.0	2.65	2.90
780	61.4	1000	6.80	1.0	2.85	2.95
815	64.1	1000	7.65	1.0	3.55	3.10
860	67.6	1000	9.20	1.0	4.16	4.04
910	71.5	1000	10.55	1.0	4.93	4.62
945	74.2	1000	11.65	1.0	5.54	5.11
975	76.6	1000	12.20	1.0	6.08	5.12
1025	79.6	1000	13.60	1.0	6.81	5.79
1070	81.5	1000	15.60	1.0	7.30	7.30

TABLE 7. ANALYSIS OF LOSSES WITH INCREASING SPEED.

It will be noted that the whirlpool-chamber losses are practically equal to the rotor-friction loss and they are therefore of equal importance.

PROPER PROPORTIONING OF IMPELLER AREAS

The radial velocity at the entrance of the impeller should never be greater than the radial velocity at the periphery. Therefore the effective area at the entrance should always be made larger than that at the discharge.

The wrong way to proportion impeller areas at entrance or discharge of an impeller is shown in Fig. 17. The radial velocity at impeller entrance is 12 feet per second, and at the discharge it is 8 feet per second. At the right of Fig. 17 the areas are represented as pipes, showing clearly the wrong proportioning.

In Fig. 18 the correct proportioning of areas is shown. The velocity at impeller entrance is 8 feet per second, which is the same as in the suction pipe. Velocity at discharge of impeller is 16 feet per second and in the whirlpool chamber the velocity is reduced from 16 to 8 feet per second, which is the velocity in the volute casing.

Fig. 19 shows the correct way to proportion impeller and diffusor areas in a turbine pump. The velocity at impeller entrance is the same as in suction pipe, 8 feet per second. The velocity at impeller discharge is 20 feet per second, which is also the velocity at the entrance to the diffusor. The velocity in the diffusor is reduced from 20 feet to 8 feet per second, which is the velocity in the casing.

Construction to Eliminate Rotor Friction

Rotor friction being one of the principal losses in a centrifugal pump, if eliminated would produce a very much higher-efficiency pump. Furthermore, higher rotative speeds could then be employed, obtaining higher heads per impeller, without increasing internal losses and therefore creating a very efficient, cheap, single-stage, high-head pump.

Fig. 20 shows such a construction, a double-suction volute pump, the casing of which has cast in it a water chamber or pocket *D*. This chamber is connected with the air chambers *C C*. In an ordinarily constructed pump these chambers are filled with water, which causes the rotor friction. In this modified design the air chambers are connected to the atmosphere by means of an automatic air valve *A*, which opens when the pressure in the pump reaches a predetermined point, admitting air to chambers *C C*. In order to prevent air from escaping into the suction of the pump, the bushing rings are put under water pressure, thereby sealing them (*B*). The drainage chamber *D* is connected to a waste pipe with a check valve in it, which opens downward, automatically, at the same time that the air valve opens.

The operation is as follows: The air valve and check valve are set to open when the pressure in the pump reaches very nearly the working point. The pump is primed and started in the ordinary way. As the pressure builds up to the working point the check valve and air valve open. All the water in chambers *C C* will immediately drop down into the pocket *D* and then into the drain pipe. All the water leaking into the chambers *C C* will always collect at the bottom and will be drained away. Thus, the impeller will revolve in air instead of water, thus eliminating rotor friction. The water that leaks past the impeller and the casing, and that from the bushing-ring seals, will be wasted, but the gain from the elimination of rotor friction more than overcomes this volumetric loss.

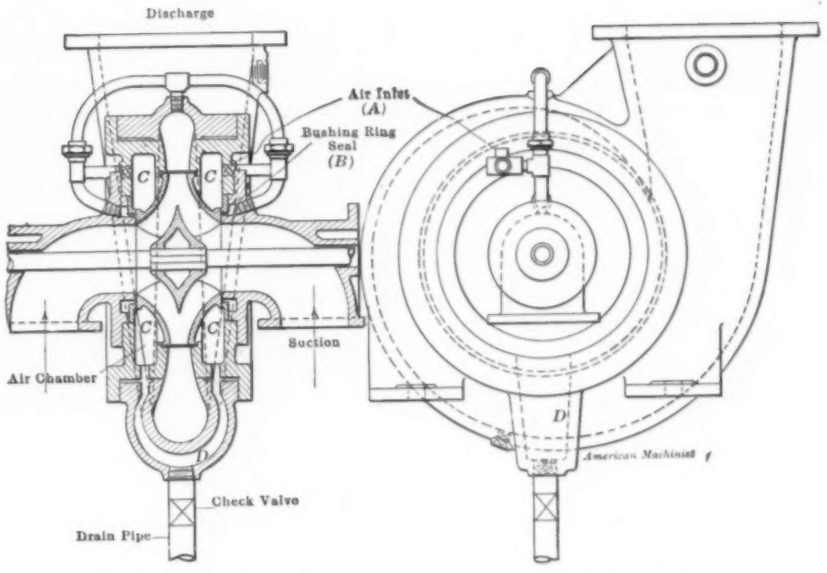


Fig. 20. Double-suction Volute, High-pressure Pump without Side-wheel Friction

A Novel Sheet Metal Job

By J. F. Hobart

A short time since I had occasion to construct a device consisting of a section of spiral (helical) steel conveyer with a sheet-metal case or cylinder fitted water tight to the outside of the conveyer section. How to make the joint water tight was the problem of the hour—and the day. There was upward of ten feet of joint to be made water tight and there was no way of getting at the joint, excepting a few inches at either end, to solder or otherwise make it tight.

It was desirable to make the apparatus of galvanized iron, though there was no limit to the material to be used except the keeping of the cost as low as possible. Several ways of making the device were schemed out and discarded.

At last the scheme was worked out of pressing the helix into as snug fitting a cylinder as possible, and then placing it in a galvanizing bath in the hope that the zinc would firmly unite the helix and the cylinder. To this end, a cylinder was prepared and fitted as closely as possible to a section of conveyer, then it was taken to a galvanizing shop with an explanation as to what was wanted. Considerable surprise was felt when it was learned that it was not a pleasant operation to regalvanize surfaces of plate already treated with zinc. To do this, the article must be lowered into the hot metal while wet with acid, an operation not to be thought of with the tortuous passages in the device under consideration.

It was learned, however, that if the device were made of *black* iron, that it could be "pickled," then treated with acid, dried and then lowered into the zinc bath. This was done and the result was all that could be desired. The molten metal just bridged over between the helix and the cylinder and the point after completion, looked as if a very small fillet had been fastened into the angle formed by the two sides. The method followed in doing the work was as follows: The black-iron sections were first placed in a strongly alkaline bath to remove all grease, then they were washed thoroughly and placed in an acid bath which ate off all the black scale and other oxides, leaving the surface of the metal bright. Then more washing was done and the articles were dipped in pure (commercial) hydrochloric (muriatic) acid and dried with the acid adhering to the surfaces.

The parts were then ready for the zinc bath and the helix was wormed into the cylinder. It was soon discovered that the helix could not be *driven* in, but by getting a strangle hold on the go-ahead end and *pulling* it along while the turning was done, it could be coaxed into the cylinder. But it could not be driven an inch. Driving made the helix larger, while pulling it made it a trifle smaller, thereby enabling it to pass into a cylinder seemingly too small to contain the helix. A dip into the zinc tank for five minutes settled the whole matter and the device has never leaked a drop since it was made.

In an interesting paper presented before the Franklin Institute dealing with the reflecting power of several new metals, including tungsten, tantalum and molybdenum, it was shown that these metals have a low reflectivity in the visible spectrum which increases rapidly to high values in the infra-red. The reflectivity curves of tungsten and of molybdenum are so nearly alike that from a consideration of their optical properties there is no great choice in the use of these two metals in incandescent lamps.

The Making of a Crank Shaft

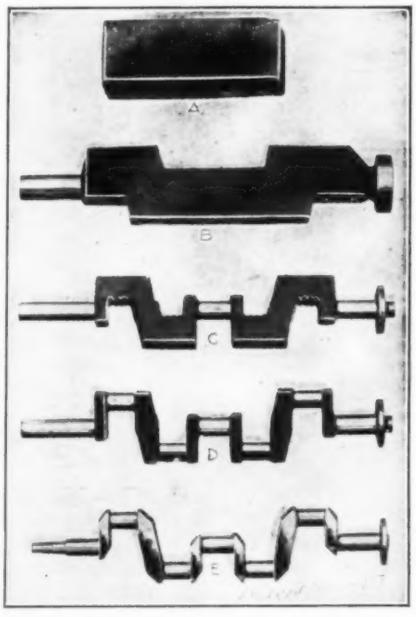
This is a picture story of the way in which the Standard Gauge Steel Company, Beaver Falls, Penn., make crank shafts, with a brief description of the methods used.

The shafts are forged from blooms not less than 7 inches square, varying according to the size and style of shaft and are made from different grades of steel. Probably from 40- to 50-point carbon steel is most used, as it has proved very satisfactory, although 3½ per cent. nickel steel is rapidly coming into favor on account of its superior wearing qualities and durability. Chrome nickel steel is also used in some cases.

Shafts are forged from a solid slab under a steam hammer, leaving sufficient material for finishing to the required dimensions.

From the forge room the shafts go to the roughing department, where the throws are drilled and sawed out, leaving the crank pins and bearings in square form, as shown in the third view.

They are next put in roughing lathes and the bearings and pins turned down to within 3/16 inch of the finishing size. At this stage they are put through a special heat treatment or oil-tempering process, by action of which the elastic limit and reduction of area are increased. This leaves toughness, combined with a uniformity of structure and strength, that gives a peculiar wearing quality, which is particularly desirable.



FIVE STAGES OF A CRANK SHAFT

The shafts are then returned to the roughing department, where they are put through a second roughing process on special pin-turning lathes, and turned down to size with an allowance for grinding of from 0.020 to 1/32 of an inch varying according to the size and diameter of the shaft and depending somewhat on the nature of the work.

The next operation is the grinding, which is done on special crank-shaft grinders. Here the bearings and pins are ground to within a limit of 0.001 inch variation in size and within 0.00025 inch of being cylindrical.

The parts are then polished and all fillets trued by hand. Every piece of work is subjected to very rigid inspection after completion—the date and inspector's private mark being stamped on it, to keep a careful check on all material leaving the works.

Locating and Boring Holes Accurately

By J. O. Barnwell

In the school shops we wanted to get the cam-shaft holes in our gas-engine cylinders located and produced with the greatest possible speed and accuracy, and with the least possible expenditure of thought and trouble. The engines were small, four-cycle, water-cooled single-cylinder affairs of the vertical marine type, rated at about four horsepower. Sufficient metal was provided in the cylinder castings at the point where the cam shaft was to be located, not only to afford strength to withstand strains but also to furnish a bearing of sufficient length to insure a support for the cam shaft, that would hold it rigidly in proper relation to the crank shaft. The problem was to get the hole in proper relation. The diameter of the half-time gear made it necessary for the center lines of the crank shaft and cam shaft to be 2¼ inches apart. These shafts, besides having to be quite accurately located as to distance, had to be parallel horizontally and also had to have their center lines in the same vertical plane.

In the beginning we intended to make a jig which could be fastened to the cylinder by bolts through the regular holes provided for the bolts holding cylinder and crank case together. However, as the bearings were babbitted, poured, and afterward scraped to fit, it appeared doubtful whether a hole produced by a jig would be accurate unless the same jig were also used to make the bearings accurate, and this did not seem practicable under the circumstances.

The cylinders were finally bolted to the platen on the table of the milling machine; the table was moved to the proper position and the hole drilled with a twist drill 1/32 inch undersize, and then bored to size with a boring bar having a taper shank fitting the spindle of the milling machine, and fitted with a single cutting point.

To properly locate the cylinder on the machine it was necessary to bolt the crank case to the table, set the crank shaft in the bearings, then move the table to a position such that the crank shaft could be held rigidly between the milling-machine centers in spindle and outboard bearing. We had to be sure that the center in the outboard bearing was opposite that in the spindle. This it would not be, unless the arm of the outboard bearing was at its lowest point when clamped in position with the crank shaft swung between centers as mentioned. To insure its being at its lowest point, we made a mark on the arm with a surface gage while the two centers on spindle and arm were touching point to point. The surface gage base rested on the milling-machine table and had a long pointer, so that when the arm was drawn out to accommodate the full length of the crank shaft, the end of the pointer would still reach the mark previously made.

When the mark and the crank-shaft centers, and the crank-case bearings were all in the places in which they should be, it is obvious that the position of the crank case was determined by the crank shaft, since the bearings in the crank case were now accurately fitting the bearing surfaces of the crank shaft. In this position the crank case was bolted solidly to the platen and a reading taken of the dial which indicated the vertical hight of the table. The longitudinal feed was also arranged to prevent accidental movement from any cause. The outboard bearing was then removed bodily, and the crank shaft was also lifted out of the crank-case bearings. The cylinder was then bolted to the crank case and the milling-machine table was lowered 2¼ inches, the distance from the center line of the crank shaft to center line of stud. The hole for the stud was then drilled and bored as previously described The gears ran very quietly when the engines were assembled. It took about one and three-fourths hours to set up the work and finish the hole.

Design of Morse Silent Chain Drives

The high-speed silent chain has become such a recognized feature of engineering construction that our readers will welcome the accompanying table of data for the design of this system of driving. The table is published by the courtesy of the Morse Chain Company, Ithaca, N. Y., and represents its most recent practice, and while giving information covering general applications, it should be borne in mind that the silent chain is practically a flexible rack, and gives a positive drive. Its use, therefore, is undesirable where the necessity of some slip exists, such as would be found in driving punching presses where the accumulated speed of the balance wheel does the work of each stroke. Caution should also be used when designing air-compressor and similar drives, in which there is a regularly intermittent torque, to see that an ample balance wheel is provided to prevent a destructive whipping action being set up in the chain. All shock loads not regularly intermittent can be taken care of with extra widths, but the makers should be consulted before designing. The following observations explain more fully some of the information given in the table presented herewith.

The limitation of the desirable number of teeth in the large sprocket, given in the fourth line of the table, is intended to give a reasonable provision for the increased pitch of the chain due to use. As is well known, the chain gradually engages the sprocket at increased diameters as its pitch increases, and, with too large sprockets, the reduced ratio of pitch to diameter reduces this provision below the desirable limit. The call in note 7 for an even number of links in the chain is intended to eliminate the special link which an odd number of links require. This can usually be brought about by a slight adjustment of the center distance. The call in the same note for an odd number of teeth in the sprockets is intended to provide a hunting-tooth effect, by which all parts of the sprocket-tooth faces are successively engaged by the links. While this is a desirable it is not an essential feature and when exact speed ratios which call for an even number of teeth are required, such teeth may be used without hesitation.

Note 1.—Number of teeth = T.
Exact outside diameter = D.
For T less than 20 teeth, D = pitch diameter.
For T more than 20 teeth, D = pitch diameter + (2 × addendum).

Note 2.—Use sprockets having an odd number of teeth whenever possible.

Note 3.—When specially authorized, a larger number of teeth than shown may be cut in large sprocket.

Note 4.—Thickness of sprocket rim, including teeth, should be at least 1.2 times the chain pitch.

Note 5.—The number of grooves in the sprocket, their width and distance apart, varies according to pitch and width of chain. In every case leave the designing and turning of these grooves to the Morse Chain Company.

Note 6.—The width of the sprocket should be ⅛ to ¼ inch greater on small drives, and ¼ to ½ inch greater on large drives than nominal width of the chain.

Note 7.—An even number of links in the chain and an odd number of teeth in the wheels are desirable.

Note 8.—Horizontal drives preferred; tight chain on top necessary for short drives without center adjustment, and desirable for long drives with or without center adjustment.

Note 9.—Adjustable wheel centers desirable for horizontal drives and necessary for vertical drives.

Note 10.—Avoid vertical drives.

Note 11.—Allow a side clearance for chain (parallel to axis of sprockets and measured from nominal width of chain) equal to the pitch.

Note 12.—Maximum linear velocity for commercial service 1200 to 1600 feet per minute.

These data are for use in preliminary design. Engineering features should always be submitted to the Morse Chain Company for approval before ordering.

Pitch, inches	¼	⅜	½	⅝	1⅛	1½	2	3
Minimum number of teeth: Small sprocket driver	13	13	13	15	15	17	17	17
Small sprocket driven	17	17	21	25	29	29	31	35
Desirable number of teeth in small sprockets	15–17	17–21	17–21	17–23	17–23	17–27	17–31	19–31
Maximum number of teeth in large sprockets. (See Note 3.)	99	109	115	125	129	129	129	131
Desirable number of teeth in large sprockets	55–75	55–75	55–85	55–95	55–105	55–115	55–115	55–115
To find pitch diameter of wheel multiply number of teeth by	0.159	0.199	0.239	0.2865	0.382	0.477	0.636	0.955
Addendum for outside diameter of sprockets 20 to 130 T. (See Note 1.) inches	0.10	0.12	0.15	0.18	0.24	0.30	0.40	0.60
Maximum R.P.M.	2,400	1,800	1,200	1,100	800	600	400	250
Tension per inch width chain, pounds: Small sprocket driver	80	100	120	150	200	270	450	750
Small sprocket driven	65	80	95	120	160	210	350	600
Radial clearance beyond tooth required for chain, inches	0.50	0.62	0.75	0.90	1.2	1.5	2.0	3.0
Approximate weight of chain per inch wide, 1 foot long, pounds	1.00	1.20	1.50	1.80	2.50	3.00	4.00	6.00
C for solid pinions	0.0045	0.0063	0.009	0.013	0.023	0.035	0.058	0.145
C for armed sprockets	0.16	0.25	0.35	0.45	0.7	1.0	2.0	4.0

Approximate Weights for Solid and Armed Sprockets.

T = Number of teeth.
F = Face in inches.
C = Constant in pounds per inch in face per tooth as per table.
Weight of armed sprocket = $T \times F \times C$.
Add 25% for split and 50% for spring and split sprockets.
Weight of solid pinion = $T^2 \times (F + 1) \times C$.

DATA FOR THE DESIGN OF MORSE SILENT CHAIN DRIVES.

Handling Work in a Railroad Shop

Editorial Correspondence

Modern ways of handling material from a heavy lathe chuck to a 120-ton locomotive.

Special clamps for boiler sheets, tires, wheels and air reservoirs.

The Beech Grove shops of the Big Four Railroad have some interesting devices to facilitate the handling of work, some of which are illustrated herewith. In Fig. 1 is a convenient and simple form of lathe crane for handling heavy chucks as well as the work to be done. It consists primarily of a 2¼-inch pipe about 7 feet long, resting in a cup bearing on the floor and supported by a brace which is bolted to the back of the lathe bed. The swinging arm is 31 inches long and carries a single pulley trolley from which a lifting hook is suspended to handle the work. This is adjustable through quite a range by the turnbuckle shown, which is easily operated by the large handwheel provided for this purpose. Full dimensions are given in the illustration.

In Fig. 2 is shown a device of a considerably different character to assist in handling complete locomotives on the 120-ton crane provided in the shop. The adjusting blocks shown are spaced the proper distance apart on the lifting cross-beam to carry the locomotive frames and these blocks are made to adjust themselves so as to secure a perfect bearing on the underside of the frame, instead of carrying the load at only one point as is sometimes the case with the plain hoisting beams. These have been found very satisfactory in this shop.

Fig. 3 shows the kind of clamps used in handling boiler sheets up to ½ inch in thickness. Its operation can be readily seen, the sheets being gripped by the ends of the lifting strap which goes on each side of the upper part of the lifting clamp itself.

Another somewhat similar clamp is shown in Fig. 4. This embodies somewhat the same ideas, but is especially adapted for handling tires both for truck and driving wheels. They are used in pairs as can be seen where they are shown clamped to the tire, and the necessary dimensions for making these can be obtained from the illustration.

An entirely different clamp, which is in reality a pair of special tongs, is shown in Fig. 5. These are used for handling tires after they have been heated and are ready to be applied to the driving-wheel center. It will be noted that one jaw of the tong *A* is made short so that it only bears against the side of the tire and does not project into or interfere in the bore in any way. The other jaw *B* is hooked so as to go inside the tire in order to lift it. In using these tongs it is necessary to always apply them as shown, with the short jaw next to the flange. They

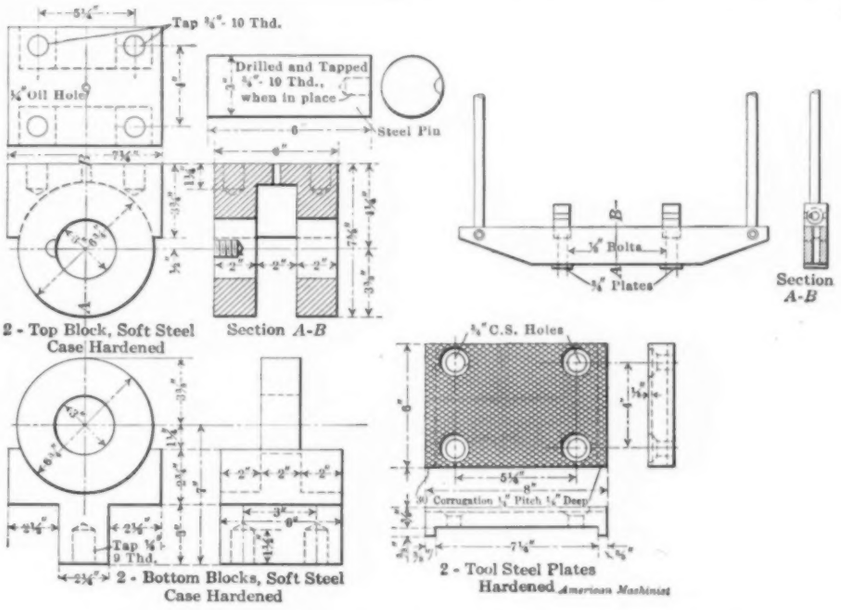

Tap ¾"- 10 Thd.
¼" Oil Hole
Drilled and Tapped ¾"- 10 Thd., when in place
Steel Pin
Section A-B
¾" Bolts
¾" Plates
Section A-B
2 - Top Block, Soft Steel Case Hardened
¾" C.S. Holes
30° Corrugation ¼" Pitch ¼" Deep
Tap ⅛" 9 Thd.
2 - Bottom Blocks, Soft Steel Case Hardened
2 - Tool Steel Plates Hardened
American Machinist

FIG. 2. ADJUSTING BLOCK FOR LIFTING YOKE ONTO 120-TON CRANE

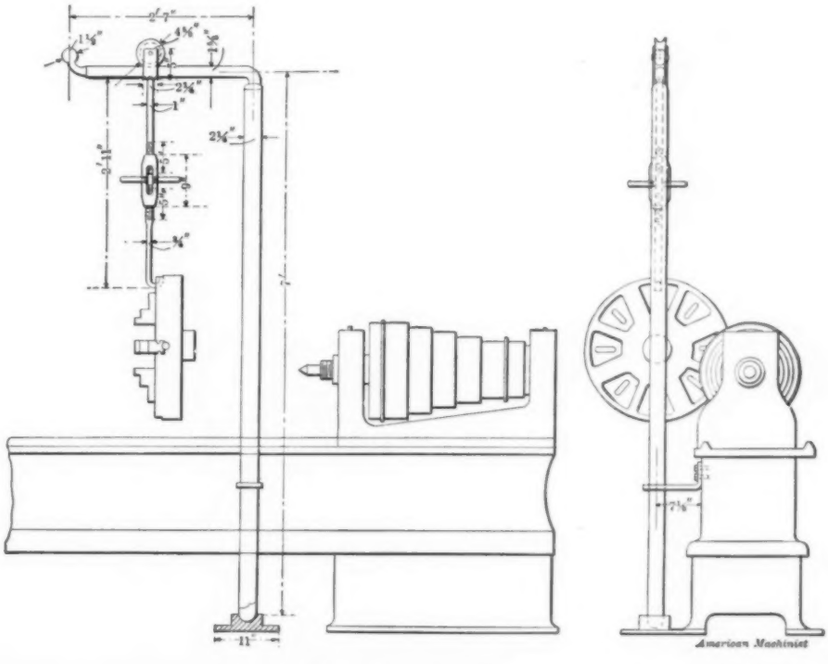


FIG. 1. LATHE CRANE

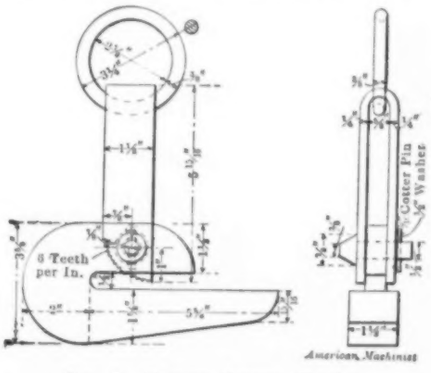


FIG. 3. BOILER SHEET CLAMP

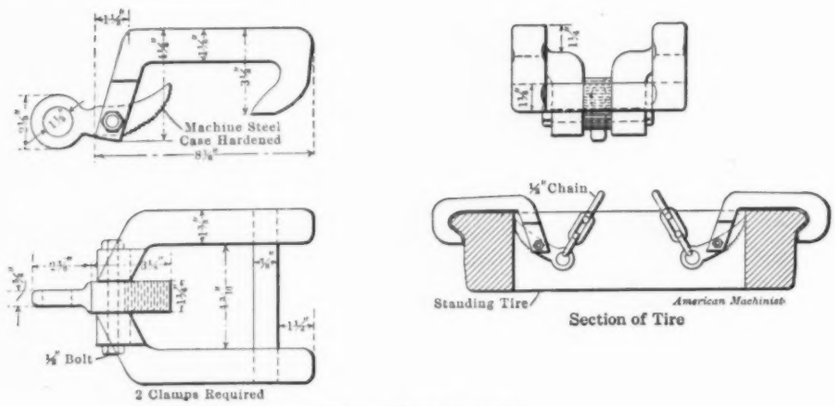


FIG. 4. TIRE CLAMPS

FIG. 5. CLAMPS USED ON APPLYING TIRES TO WHEEL CENTERS

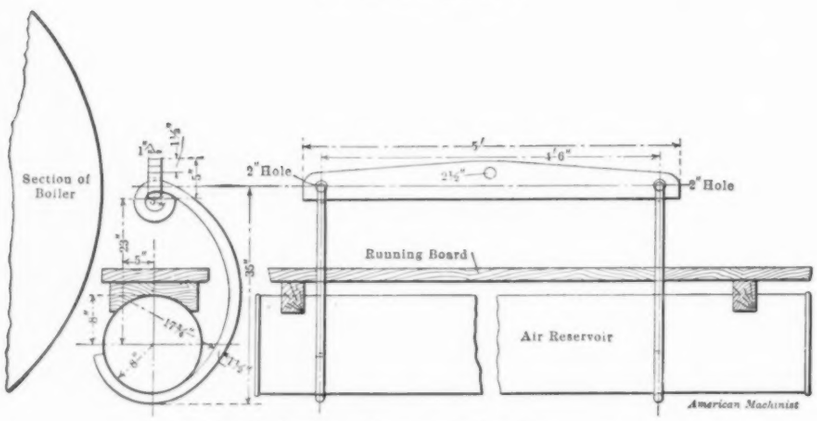


FIG. 6. LIFTING HOOKS FOR AIR RESERVOIR

can then be easily slipped over the wheel center after being expanded by heat and by the time the projecting end of the jaw *B* comes against the wheel center the tire can support itself and the tongs.

Another convenient lifting arrangement is shown in Fig. 6. This finds favor in handling air reservoirs under the running board, and is much easier and better in every way than attempting to handle these by hand. These methods need no explanation as it can be readily seen that the shape of the supporting hook allows the reservoir to be lifted underneath the running board, and held easily in position until it is firmly secured by the proper clamping band.

The development of aërial navigation in France is reflected in a petition presented to the minister of public works, urging that all electric transmission lines be provided with electric signals to warn alighting aviators.

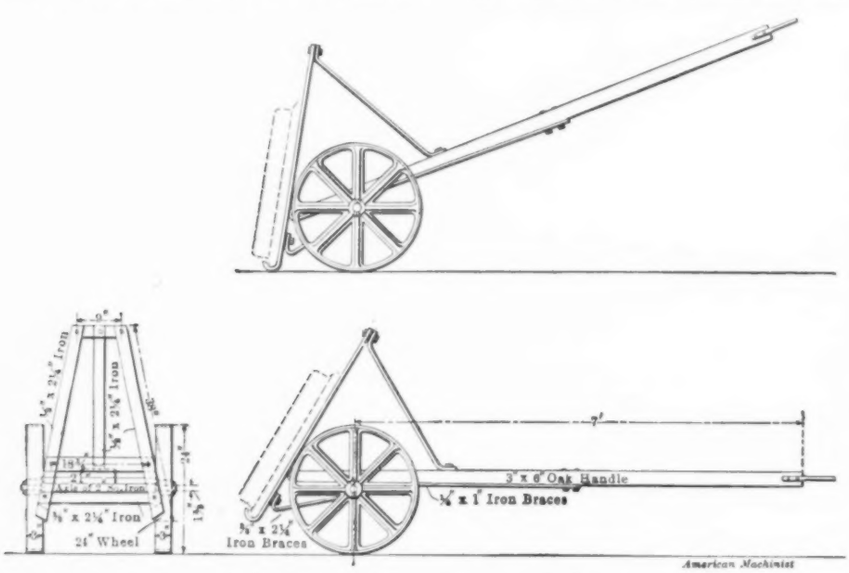
A Handy Car Wheel Truck

By Charles Markel

Attached print shows new cart which we just made to handle locomotive and car wheels from platform to wheel room. Before this was built we had to roll them, which was dangerous when first attempted by new men who had never rolled them.

This cart in the hands of two laborers will handle the wheels very easily on account of the 24-inch wheels, and there is no danger from wheel getting away and causing injury.

The illustration gives details and will interest anyone who has this class of work to do. This truck was designed by machinist O. Godiskesen.



A HANDY CAR WHEEL TRANSFER TRUCK

Coaling Battleships at Sea

Coaling war vessels at sea is a problem which has occupied the minds of naval men for many years, and although partly successful in its solution ten years ago, the results have not been entirely satisfactory.

It is now said that the United States navy men have constructed a cableway device which is truly successful. Reversing the old method, it is now proposed to have the collier tow the man-of-war, and the old sea anchor formerly used to keep tension on the cableway lines, is to be replaced by a new winch which automatically takes up the slack and puts on efficient tension to enable the carrying of several thousand pounds of coal at a time.

By having the collier do the towing, the coal is now handled upon the forecastle of the warship, instead of being dumped upon the quarterdeck, to be dragged forward by the crew, as formerly.

Backing Off Spiral Fluted Hobs

By Walter G. Groocock

Statement of the general case, with simple formulas, showing how the backing off can be done without special fixtures and without resorting to either "dodging" or rough approximations.

Several practical examples worked out to suit special machine conditions.

Best form of cutter and method of making worm-hob gage.

Being at all times interested in hobs and hob problems, more especially when a graphical solution is given, I read with care the article by O. R. Briney which appeared in Volume 33, Part 1, page 883, on the above subject, and was rather surprised at the long way round he adopted to get a result, which was, owing to an arithmetical error, shown wrong on his diagram 1. In diagram 2 there is also an error, as after altering the lead of his spiral flute, he still leaves the angle 90 degrees on his diagram.

I should not have called attention to these errors, nor have commented on Mr. Briney's method of solving these problems, but for the fact that two young toolmaker friends of mine got in a tangle with the article and came to me to straighten it out for them.

Their difficulty was in trying to arrive at a general case, and in doing this they got up against the errors mentioned. While giving them the general case to cover hob questions, or problems, either for use with simple attachments, or special machines, it occurred to me that other young readers of the AMERICAN MACHINIST might be in the same trouble, and this article has been written, not to criticize Mr. Briney's article, but with a view to clearing the matter up by putting the case as a general proposition.

Digressing a moment from the subject

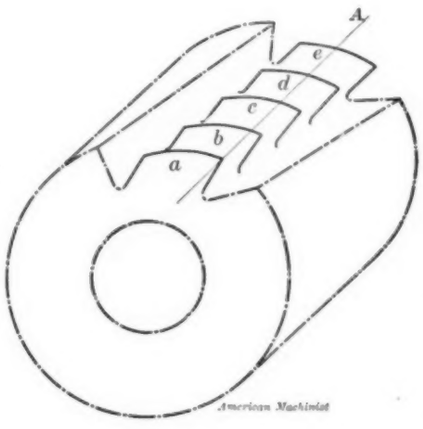


FIG. 1. THEORETICAL AND ACTUAL FLUTE LINES

matter of this article, it is a matter for general congratulation to find so many young mechanics who read the AMERICAN MACHINIST today, compared with the number who read it when the European edition first came out, and this is all the more gratifying when we consider that they are the engineers of the future, and for that reason we should endeavor to give them in all shop problems, first a general case, and then a worked example, for my experience is, that speaking generally, the young mechanic of today if given a formula or equation for the general case, can work out any special case desired, but on the other hand they find a difficulty in working back from the special to the general case. That is, they are not generally adept at mathematical

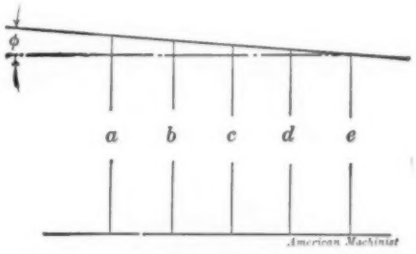


FIG. 2. PLOT OF CONDITIONS SHOWN IN FIG. 1

juggling. This is, of course, true of the majority of shop men with whom I class myself.

THE GENERAL CASE

Returning to our subject, let us first state the general case for the ratio of wheels to back off any number of flutes, on any machine, when the flutes are normal or approximately normal to the thread. This is given by the equation:

$$R = \frac{N}{G}\left(1 + \frac{P}{L}\right)$$

where

R = Ratio of wheels required,
N = Number of flutes in hob,
P = Lead of hob,
L = Lead of spiral grooves or flutes,
G = A constant for each particular machine, and is a function of the number of cam rises and the machine gear.

G is variable for different machines, being 3 in the Pratt & Whitney attachment and 12 in the Loewe lathe, but as we are not concerned with any particular machine we can leave out G, and our equation boils down to:

$$R = N\left(1 + \frac{P}{L}\right)$$

in which, as we have dropped G, R = the number of flutes to gear up for.

Applying this to the example given by Mr. Briney we have, using his original lead:

$$R = 5\left(1 + \frac{8}{19.74}\right) = 7\tfrac{6}{25} \text{ approximately}$$

and not $7\frac{8}{25}$ as stated. Taking the second lead:

$$R = 5\,(1 + \tfrac{2}{10}) = 7$$

It will be seen how much easier it is to deal with, than by the method of proportional parts as used by Mr. Briney.

WORKING BACK TO CONDITIONS

Since there is a probability of having to change some of our quantities, it is obviously waste of time to consider the fourth, or even the third place of decimals.

For instance; Mr. Briney, after working to four places of decimals, says, he could not gear up to suit 7, the answer he had arrived at, but instead he used $6\frac{2}{3}$. Since he could not use his answer when found, the better course would have been

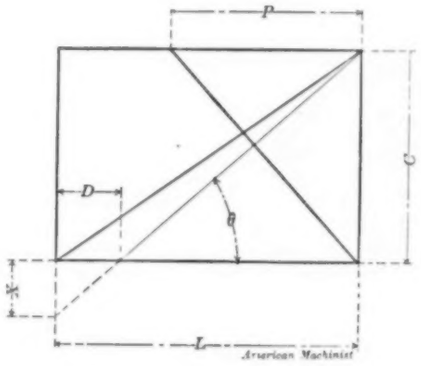


FIG. 3. FINDING ANGLE FOR TAPER ATTACHMENT TO CORRECT FOR ACTUAL LEAD OF FLUTE USED

to have worked back from what he knew, for since

$$R = N\left(1 + \frac{P}{L}\right),$$

and if R is known (in this case $6\frac{2}{3}$) then we can make L the unknown, for

$$(R - N) = \frac{P \times N}{L},$$

and from this it follows that:

$$L = \frac{P \times N}{R - N}$$

Now apply this to the special case and we get

$$L = \frac{8 \times 5}{6\frac{2}{3} - 5} = \frac{120}{5} = 24.$$

Now, a 24-inch lead can be cut on any milling machine, and being absolutely correct for our ratio, it does away with all the dodging mentioned by Mr. Briney for bringing up the first tooth and then alternately bringing up every tooth afterward. It also does away with the accurate chasing spoken of by him, which is obviously doing work over twice; besides, this method of trying to dodge an existing form is very crude and is likely to lead to serious errors, even with the most careful workman. When, as may happen, the lead of the flute and the ratio of the gear used are not quite in agreement, it is the simplest of matters to put this right. All that is required is to set the taper attachment to counteract the error, or set over the tailstock for the same purpose.

Effect of Difference Between Gear Ratio and Spiral Lead

That any difference between the ratio of the gears, and the lead of the spiral used, results in a taper, can be proved diagrammatically as shown in Figs. 1 and 2.

In the hob outlined in Fig. 1 the full lines represent five teeth *a*, *b*, *c*, *d* and *e*, showing how they stand in relation to each other as milled and backed off. Now let the line *A* represent the theoretical flute to suit the wheels used. If now we take off from each tooth the distance from the center of hob to the intersection of correct flute *A*, and plot these distances as ordinates, as shown in Fig. 2, with unit

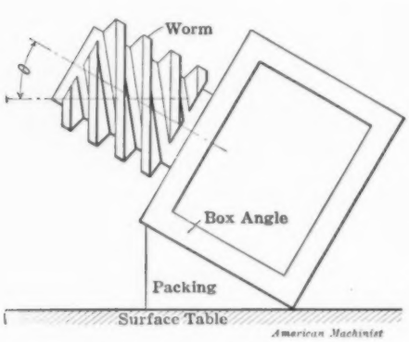


Fig. 4. Getting the Curve of the Gage

distance between, a straight line will pass through the points, and ø, Fig. 2, is the angle that it makes with hob axis.

From this it follows, that, if we set over the taper attachment to a corresponding, but opposite taper, we shall produce a parallel hob, and meet the flutes.

Setting Taper Attachment

To find the angle for setting the taper attachment to correct for a difference between the theoretical and actual lead of flute used, take the difference between them, *D* in Fig. 3, and multiply by the tangent of the angle that the theoretical flute makes with hob axis, θ in Fig. 3; multiply by the number of flutes in hob and also by rise of cam (in inches); divide by circumference of hob *C* on pitch line, and also by the actual lead of flutes, and this gives the tangent of the angle required, i.e., ø in Fig. 2.

This will be seen more freely by referring to diagram, Fig. 3, where *D* times $Tan.\ \theta = X$ = the gain or loss, by reason of difference in lead of flutes, during one length, *L*. The heavy line represents the actual and the thin line the theoretical flute. Now *X* divided by *C*, and multiplied by the total cam rise measured round circumference, gives us the amount of taper in the length *L*. Therefore, if we divided by *L* we get the tangent of the angle.

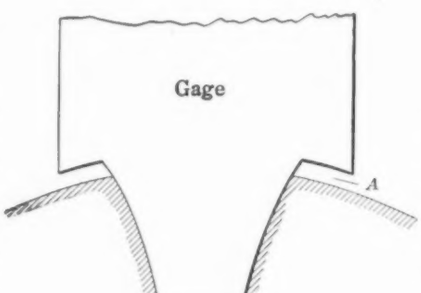


Fig. 5. The Gage for Worm Hob

Practical Considerations

In nearly all shop calculations we can simplify by departing from absolute mathematical exactness, while at the same time keeping within the limits of our methods of workings. In practice, the difference between the angles made by the theoretical and actual flute is so small that we may use the angle made by the actual flute instead of that of the theoretical (as given above) and then we can simplify, because $Tan.\ of\ actual\ lead = \frac{circumference}{lead} = \frac{C}{L}$, and putting the above matter into an equation, we have

$$Tan.\ \phi = \frac{D \times \frac{C}{L} \times N \times cam\ rise}{C \times L};$$

which at once reduces to the simpler form:

$$Tan.\ \phi = \frac{D \times number\ of\ flutes \times cam\ rise}{(lead)^2},$$

and this is sufficiently true for all cams having unit rise per unit angular movement, which is the general practice.

Generally these angles are so small that it is much quicker to set attachment over until the backing off follows the line of flute, and as the top is usually backed off first, the setting is easily accomplished, the top being in full view.

It may be contended that setting over the taper attachment will alter the pitch. Perhaps it will, but the heat generated in working the hob will also alter the pitch, so will breathing on it (if we could measure it) and as the amount set over is always very small we may neglect its effect.

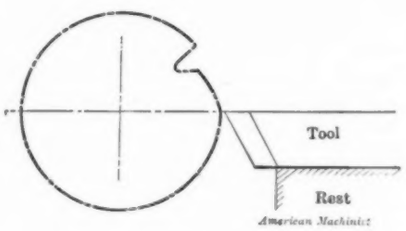


Fig. 6. The Hob and the Tool

Making the Worm Hob Gage

One of the difficulties of making worm hobs is, how to gage their shape normal to the thread, and this is so little understood that very often the gages are straight sided, and in one large tool-room recently I saw gages for worm hobs (normal) that had straight sides and a smaller angle than the worm gages, which is obviously wrong, as from spiral-gear data, we know that the smaller the angle θ, Fig. 4, becomes, the nearer we approach the rack in form, and conversely, the larger it becomes the nearer we approach the form of the pinion, and this would mean a larger angle for the space, assuming for a moment that the sides were straight.

This is easy to understand and prove, if one cuts out a few rack teeth in paper, and then bends it round a cylinder in the form of an helix.

Now the only point where the orthodox (involute) worm side is straight, is on the line of the worm axis, consequently, if we gage the thread at the flute, i.e., normal to thread, then the form of the gage is a curve, and where this curve is desired, the simplest way to get it and to make the gage, is to take the worm for which the hob is required, and after scribing a line along to represent the axis, tilt it up to the angle that will correspand to the normal, and scribe another line intersecting the first at the center of a space. Fig. 4 shows the method. If, now, we file up a gage to fit space along this line, allowing for the extra hight of hob tooth and equal shortage as at *A* and *B*, Fig. 5, we shall have a correct gage.

It is not at all necessary, however, to have a gage, because if the tool producing the hob is ground to a straight line, and its top (cutting edge) makes a straight line with center as shown in Fig. 6, it will develop its own curve, and correctly, if cutting edge makes correct

angle with lathe centers, and the tooth micrometer will take care of the thickness.

For the benefit of the younger readers it might be stated that the thickness normal to flute is found by multiplying the thickness on the line of axis (linear thickness) by the cosine of the angle that the flute makes with the axis, i.e., angle θ in Fig. 4.

For the better understanding of worm gears, and hobs for producing them, the young mechanic could not do better than add to the library, "Worm and Spiral Gearing," by F. A. Halsey, for a worm hob with its flute normal to thread is nothing more than a spiral gear that will cut.

Best Form of Cutter

Mr. Briney, in his article shows a cutter for fluting hobs with an angle on one side and straight on the other. For fluting hobs with spiral grooves, it is essential for good work that the cutter shall have a double angle, and we have been using for many years, cutters with the side teeth staggered, similar to those made made by Pratt & Whitney, for use in their thread-milling machine. These give excellent results, owing to the proportionately larger teeth that can be put on the sides by staggering them, for by this method one gets, say, 40 teeth on the periphery and 20 on the side. We make these as follows: The smallest 2¾ inches diameter, with sides 10x10 degrees and the largest 7 inches diameter, with sides 20x20 degrees; the thickness on the circumference ranging from 1/10 inch to 3/16 inch, and rounded off to form a radius.

Recapitulation

Recapitulating, and summarizing the equations necessary for hob problems, we have: For finding lead of flute L, when circumference of hob C, and lead of hob P are known:

$$L = \frac{C^2}{P}. \qquad (1)$$

For finding number of flutes to gear up for, when number of flutes on circumference, lead of hob, and lead of flute spiral, are known, we have:

$$R = N\left(1 + \frac{P}{L}\right). \qquad (2)$$

Then for the case where we know the R that we can gear up for, and also P and N are known, we have:

$$L = \frac{P \times N}{R - N}. \qquad (3)$$

An Example Worked Out

To make the formulas quite clear, let us take a concrete case. Required to be made, a hob with five spiral flutes; pitch circumference = 12 inches; and lead of hob = 10 inches. Then from above data, using (1) we get:

$$L = \frac{(12)^2}{10} = 14.4 \text{ inches},$$

and ratio of flutes to gear up for, we get from (2)

$$R = 5\left(1 + \frac{10}{14.4}\right) = 8.47.$$

Suppose, now, we can gear up only for 8 flutes, then our new lead of spiral will be, from (3)

$$L = \frac{5 \times 10}{8 - 5} = 16.67 \text{ inches}.$$

This lead can be cut by most milling machines, but suppose it could not, and the nearest lead was 17 inches, and we desired to find the angle for correcting by the taper-attachment method. If the rise of the cam is 1/10 inch, we have

$$Tan.\ \phi = \frac{0.33 \times 5 \times \frac{1}{10}}{(17)^2} = 0.00057$$

and the angle is 0 degree 2 minutes, approximately.

It will be seen how very slight a correction will put right a fairly large error in lead by this method.

The slide rule is excellent for hob calculations, being at once rapid and within the limits of accuracy desired or required.

The Compass for Hardening Heats

By George Coles

A short time ago I received a circular from a prominent steel company, calling my attention to their method of gaging the proper heat for hardening carbon steels.

The illustration in their circular showed an open furnace, inside of which was a horseshoe magnet swinging on a hook and holding a large milling cutter; the idea being, that when the magnetism leaves the cutter it will drop from the magnet; this being the critical moment that we have all been looking for, and that is the correct heat at which to quench the tool to get the best results.

From experimenting over three years in this particular line, I have proved to my satisfaction that this method is good, but I proceed a little differently.

I found that the magnetism left the steel at a certain temperature, and that I could tell when it left by the compass. I therefore purchased one for $1.50 and rigged it up on a stool close to the furnace. By occasionally testing the tool with the compass, as shown in the illustration, and watching my pyrometer I found the hardening heat and time of departure of the magnetism to be the same.

In other words, I found that if I quenched the tool the moment the magnetism left the steel, I had a hard fine-grained tool, that with the proper tempering was just what was wanted. Continued tests on tools, hardened this way,

Judging Hardening Heats with Compass

proved satisfactory, as the verdict in the shop was: "Those tools are the best we've ever used, why don't you harden 'em all that way?"

We all know that a 1.00 per cent. carbon steel will harden at a lower heat than an 0.80 per cent. steel, and also that a 1.10 or 1.20 per cent. carbon steel will harden at a still lower heat. My experiments also proved that the magnetism left the steel at different temperatures, corresponding to the carbon percentage.

For instance, a 1.10 per cent. carbon steel will harden at from 1325 to 1330 degrees Fahrenheit; the magnetism leaving the steel at that temperature. With an 0.85 per cent. carbon steel the magnetism leaves at a considerably higher heat and therefore the hardening heat is correspondingly higher.

In this way a man can harden a piece of steel of any carbon content, and make a success of it the first time.

My method is to place the compass near the furnace in such a way that everything is clear on the north side. When the tool gets to a dark red, test it by swinging it east and west close to the compass. If it is not hot enough it will be magnetic and the needle will be deflected. Continue this at intervals of a few moments, until the tool does not attract the needle. Then put the tool back in the furnace to absorb the heat lost in testing, but not any more, and immerse in water until the hardness is set, and then in lard oil until cold.

Some allowances must be made for the surroundings, as any iron or steel near the compass may draw the needle away from due north. This makes no difference, however, as the movement of the needle tells whether the magnetism is there or not. If the tongs deflect the needle, they can be made of nickel steel. The idea is to catch the heat at the right time and the compass or even the horseshoe magnet is a great aid.

Proportions of Flexible Couplings

EDITORIAL CORRESPONDENCE

The use of flexible couplings often makes a convenient solution to the problem of driving electric or other machinery, when the foundation may not be all that might be desired, as it avoids the necessity for exact alinement, and, unless both parts of the apparatus are on the same foundation, it is no easy matter to maintain alinement even after it has been secured.

The connection of motors to all sorts of machinery makes a large field for couplings of this kind and the following tables, taken from the bulletin of the General Electric Company, show their practice in this respect and the data tabulated on this important question should prove useful to manufacturers.

Two kinds of couplings are shown, one having flat leather links and the other two endless belts placed side by side on the forks or arms of the spiders, as can be seen in the diagram in Fig. 2. The belting used is a specially prepared leather which is designed to be used with a tension of 400 pounds per square inch of cross-section, the rating being given both in kilowatts and horsepower, per revolution. The work performed by couplings of this kind is greater than would be expected of the same cross-section of belting, owing to the absence of slippage and the fact that it is firmly supported by the other parts of the coupling.

The question of which style of coupling to use depends upon the conditions of each particular case.

Grinding Wheels Not Softer Near the Center

Complaint is sometimes made that wheels appear to be softer toward the center. Usually this is because the same surface rate of speed is not maintained as the wheel is reduced in diameter. This causes the wheel to wear away faster and appear softer. It is also true that while the grade of the wheel may be uniform throughout, yet the smaller line of contact due to the smaller diameter will cause the wheel to appear softer.

Another reason is because each particle or grain of abrasive is called upon to do more work as the wheel reduces in diameter and naturally wears faster.

Speed up the spindle as the diameter of the wheel is decreased. The efficiency of any grinding wheel depends upon a correct periphery speed and the correct speed should be maintained, so far as possible.—*Grits and Grinds.*

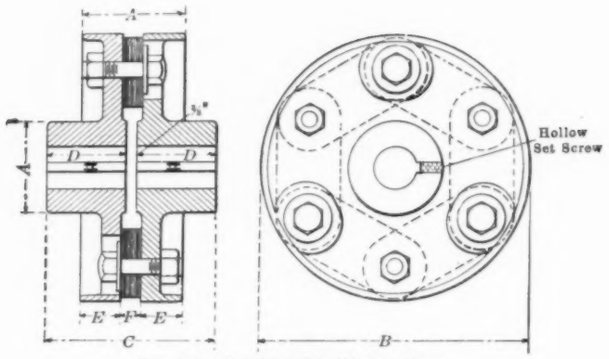


Fig. 1. Leather Link Flexible Coupling

Bore	Dimensions						Rating per Revolution with 400 Lbs. per Sq. In. Tensile Stress in Belt		Max. R. P. M.	Weight in Lbs.
	A	B	C	D	E	F	Kw.	H. P.		
3/4	1 3/8	3 3/8	2 7/8	1 1/4	11/16	3/8	0.0012	0.0016	1800	2 3/4
1	2	5	4	1 13/16	7/8	3/8	0.0032	0.0043	1800	7 1/4
1 1/2	2 3/4	6 3/4	6	2 13/16	1 1/16	3/8	0.0076	0.0102	1800	15
2	3 1/2	8 1/4	8	3 13/16	1 1/8	3/4	0.0149	0.0200	1800	27
2 1/2	4 1/8	9 1/2	10	4 13/16	1 7/16	3/4	0.0258	0.0346	1800	43
3	5	11 1/8	12	5 13/16	1 3/8	3/4	0.0410	0.0550	1800	75
3 1/2	6	12 1/2	12	5 13/16	1 13/16	1 1/8	0.0612	0.0821	1800	103

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TABLE 1. DATA ON LEATHER LINK COUPLINGS

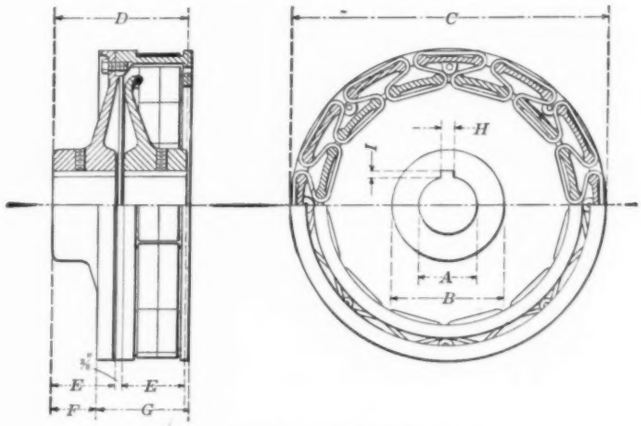

Fig. 2. Dimensions of Laced Belt Flexible Coupling

Bore	Dimensions								Rating per Revolution with 400 Lbs. per Sq. In. Tensile Stress in Belt		Max. R. P. M.	Weight of Complete in Lb.
A	B	C	D	E	F	G	H	I	Kw.	H. P.		
1	2	5	3	1 5/16	11/16	2 7/16	1/4	1/8	0.0032	0.0043	1800	8
1 1/2	3	8 1/4	4	1 13/16	7/8	3 5/16	3/8	3/16	0.01492	0.02	1500	27
2	3 1/2	9 1/2	5	2 5/16	1 5/16	3 13/16	1/2	1/4	0.0258	0.0346	1500	39
3	5	15 1/2	6	2 13/16	1 5/8	5 1/16	3/4	3/8	0.1196	0.1604	1200	115
4	6 3/4	18 1/2	8	3 13/16	2 9/16	5 1/2	1	1/2	0.2066	0.277	900	189
5	8 3/8	24 1/2	10	4 13/16	3 7/16	6 13/16	1 1/4	5/8	0.4901	0.657	750	367
6	9 7/8	30 1/2	12	5 13/16	4 7/16	7 9/16	1 1/2	3/4	0.9573	1.2832	600	611
7	11 3/8	37	14	6 13/16	5 3/16	8 1/4	1 1/2	3/4	1.654	2.2176	450	1033
8	12 3/4	43	16	7 13/16	5 15/16	9 1/8	1 3/4	3/4	2.627	3.5215	350	1527
9	15 1/4	49	18	8 13/16	6 15/16	9 7/8	2	7/8	3.9214	5.2566	300	2201
10	16 3/4	49	20	9 13/16	7 15/16	9 7/8	2	7/8	3.9214	5.2566	300	2376
11	18 1/4	55	22	10 13/16	8 13/16	10 9/16	2 1/2	1	5.5833	7.4844	250	3171
12	19 3/4	55	24	11 13/16	9 13/16	10 9/16	2 1/2	1	5.5833	7.4844	250	3439
13	21 1/2	61	26	12 13/16	10 13/16	11 3/16	2 1/2	1	7.6591	10.2669	200	4485
14	23	61	28	13 13/16	11 13/16	11 3/16	2 1/2	1	7.6591	10.2669	200	4831

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TABLE 2. DATA ON LACED LEATHER COUPLINGS

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

A Locomotive Throttle Seat Reamer

Fig. 1 shows a throttle seat reamer which is used in the drill press to true up the seats if slightly cut or out of round. This class of work is usually done in a lathe by clamping the throttle box to the face plate and using the usual tool in tool post, which is a slow and very unsatisfactory method. All that is required with this tool is to bolt the throttle box to the bed plate of the drill press and insert the tool shown in the drill-press spindle and two or three revolutions of tool will make a first-class job on both seats. The cut shows the seating tools in position. If the seats on the throttle box are too wide the seating tools are removed and facing cutters *A* and *B*, Fig. 2 are put in their places which face down the seats to proper width. Another great advantage of this tool is that all seats are duplicate and by having a gage made from a finished seat the throttle can be quickly and accurately fitted to the seat in the box. The facing and seating tools are made from high-speed steel and are

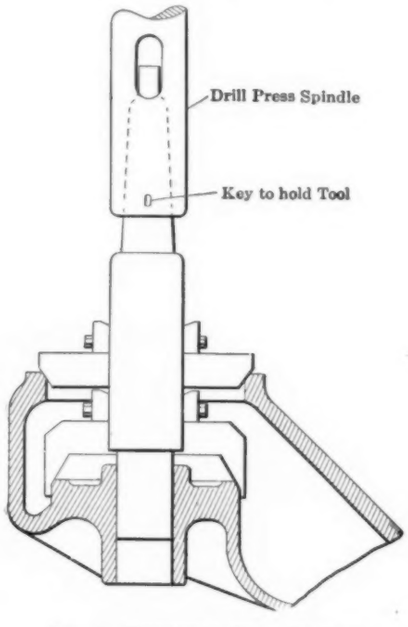


FIG. 1. THROTTLE SEAT REAMER

notched as shown to fit the arbor, which always locates them central. They are held in place by four wedges drawn together by the stud as shown.

Fig. 2 gives the details of the reamer, which I feel sure will be appreciated by any railway shop doing this class of work on the face plates of lathes.

Clinton, Iowa. W. J. SHADLE.

Sawing Thin Tubing

Probably every machinist has been up against the stunt, at some time or other, of having to cut off a lot of thin brass or steel tubing with an ordinary hack saw. This job will break the teeth out of a saw faster than the cutting off of any amount of heavy metal. In fact, unless great care is taken, it is almost impossible to saw off a ½-inch tube without breaking out from one to three teeth. The reason for the breakage probably lies in the fact that the wall thickness of the tube is so slight that it goes to the bottom of the spaces between the teeth and when pressure is applied, it acts as a breaking strain upon the face of each tooth. Once a tooth is broken out, the momentum of the moving saw is greatly increased by the additional distance it may travel before striking the next tooth, and the rapidity of the breakage is greatly increased as soon as one of the teeth gets broken.

I have spoiled a new saw in cutting off three lengths of ½-inch brass tubing and was obliged to obtain some jeweler's saws (they have very fine teeth) in order to complete the job. Since then, it has been necessary to cut off a lot of very thin-walled tubing and fine-toothed saws could not be obtained in time. To get out of the difficulty, two saws were inserted in the hack-saw holder at the same time, and placed side by side. Two saws were selected which, when placed together, would lie with the teeth of one opposite the spaces in the other saw. When the pin holes did not come quite right to permit this, the temper was drawn from the ends of the saw—if there was any temper therein—and the holes were enlarged slightly to permit the saws to bear equally against the pins and the teeth of one to come exactly opposite the spaces in the

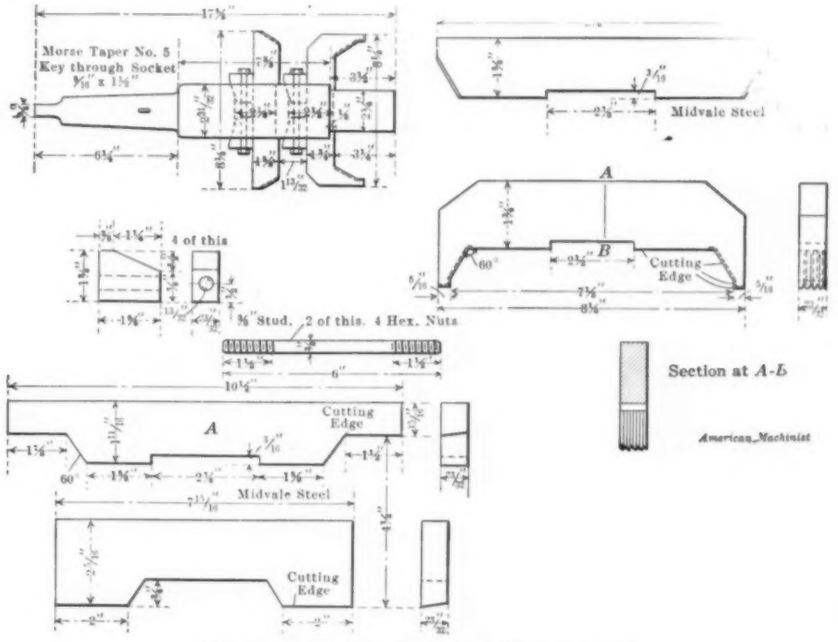


FIG. 2. DETAILS OF THROTTLE SEAT REAMER

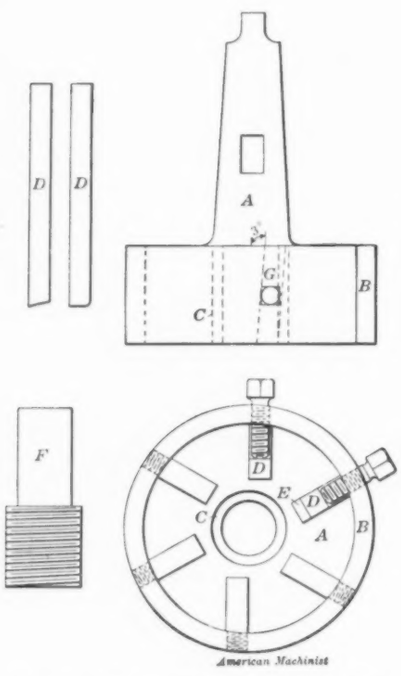
other saw, as noted elsewhere. With saws thus arranged, there was never a tooth broken. The kerf removed was, of course, more than would be cut by a single saw, but it amounted to very little and permitted a perfect cut, no matter how the saw was held or crowded against the work. Most saw handles will permit two saws to be inserted with a

very slight enlargement of the slots. This may be readily done by running a saw into the slot beside a piece of old saw blade from which the temper has been removed.

South Bend, Ind. J. F. H.

Tool for Turning Solid Grease Cups on Locomotive Connecting Rods

This tool was designed for use on the type of connecting rods that have the grease cups forged solid on them. The inside of the grease cup is machined first and tapped. The plug shown at *F* is then screwed in, being made to fit the cup and the shank to fit the hole in the center



TOOL FOR TURNING SOLID GREASE CUPS ON LOCOMOTIVE CONNECTING RODS

of the tool, which is bushed with a hardened bushing *C*.

This tool was made to fit a rod boring machine with a long table to accommodate the whole length of the rod which is strapped down so that the plug *F* screwed in the grease cup, enters the hole in the bushing *C* when the tool is in the machine.

The cutting tools *D* are made of ⅞-inch square mushet steel. The slots *G* for holding the tools are cut on an angle of 3 degrees with the center, that gives them a little lip and also gives them all the side clearance necessary.

The slots *G* were milled in the holder and then the ring or band *B* was turned and shrunk on. The slots *G* are so placed that when the tools *D* are the proper distance out from the holder the cutting edges come right on the center line.

This holder was made with different sizes of shims or blocks shown at *E*. They could be quickly changed and thus with the proper thickness any size could be obtained in a short time.

These blocks *E* were also sometimes used to stagger the tools when a forging was so large that the width of the tools did not clean it up.

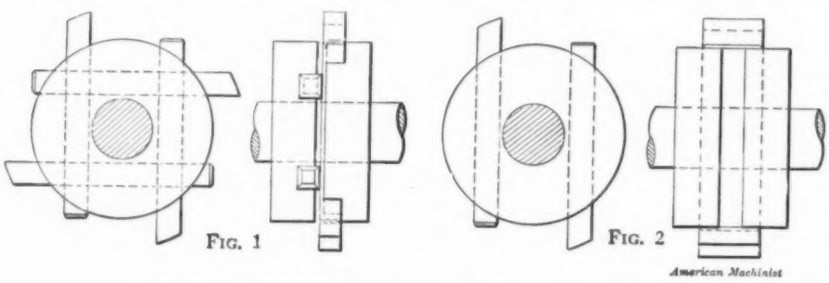
Elmira, N.Y. JOHN DENSE.

An Emergency Cutter for the Milling Machine

Whether it be for formed milling, or for simply machining work to arcs of circles, or a combination of these operations, the cutter described here will be found very useful. It may not be new, probably it is as old as the hills, but no one who tries it goes back on it.

Two steel disks are required, and they may be cutter blanks, or even obsolete or worn-out cutters, if these are on hand and are of suitable dimensions. If cutter blanks are to be used no preparation will be needed, but two slots may be machined straight away as shown in the sketches. No dimensions are given, but the slots may be of such a width as to take tool-steel stock of a suitable size straight from the bar without any machining. The depth of the slots in the disks should be a little less than the thickness of the tool-steel stock; that is, if square stock be used. Both disks should have the slots in exactly the same position, so that if it be required to use a wide cutter, the slots in both disks will match and so accommodate either a wide cutter, or a narrower one.

By using tools in the slots of one disk only, or by using the disks with the slots, not matching, as shown in Fig. 1, or with wide tools fitting in both disks at once, Fig. 2, and by having plain or formed tools, quite a range of work may be covered. The cutters themselves may be readily adjusted for curved work when this must be of a given radius, as in segmental punch and die work. The device is a very valuable addition to the outfit of the machine, and for large work is superior to the fly-cutter arbor, and unlike that useful tool, may be used in any position on the usual cutter arbor. In shops where much experimental work is done it is indispensable, as by its use all the advantages of a formed mill may be had, at the simple cost of making a formed turning or planing tool.

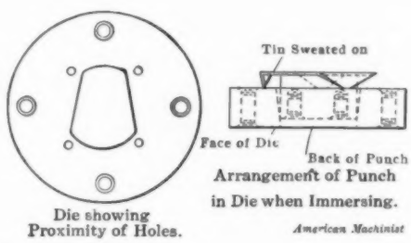


AN EMERGENCY CUTTER FOR THE MILLING MACHINE

London, Eng. W. O. FALK.

Preventing Die from Shrinking

Here is a case of a die where one large piercing hole is surrounded by several smaller ones so close as not to admit of bushing. In the process of hardening it is sure to shrink a considerable amount,



PREVENTING DIE FROM SHRINKING

varying with the size of hole, stock, etc. This is almost impossible to allow for in laying out the small holes.

To prevent this shrinkage the large punch is made first, parallel and separate from the punch plate as shown in the sketch. After hardening the punch the die is made to fit it.

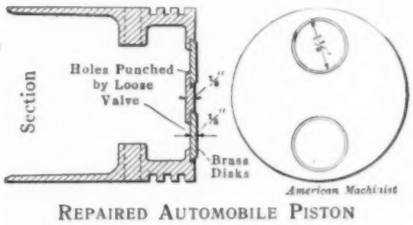
When the die is heated ready to dip, the punch is dropped in it far enough for the back edge of the punch to come about 3/32 from the face of the die; that is, supposing the die has about 5/32 of straight. This position is insured by previously fastening a piece of tin on the face of the punch and bending the corners over the stops, as shown. In the particular case in hand the die shrunk only 0.001. As the face of the punch is removed from the heated die there is no fear of drawing the temper if the job is done smartly.

Middletown, Conn. J. H. B.

Repairing Automobile Engine Piston

The accompanying sketch illustrates a small repair job that may possibly interest some of my fellow mechanics, as it was a forlorn hope that was successful repaired.

The boss has a model 10 Buick automobile, which is in constant demand, he could no more do without it than without



REPAIRED AUTOMOBILE PISTON

three meals a day. This car is, as a rule, as reliable as a grandfather's clock. I was, therefore, taken aback one day when a team of flea-bitten mules towed it ingloriously into the shop with its colors down.

Upon cranking, the engine rattled like a keg of nails and refused to start. Further investigation revealed the fact that an inlet-valve stem had crystallized and broken, and the valve had dropped down inside the cylinder. Being harder than a cast-iron piston, the piston suffered most. As a result, there were two holes punched through its top that looked like the place where a man has fallen through the ice.

The piston was practically ruined, but as we could not get another for several weeks, I took the old one and scribed two circles covering the holes and cracked metal. One of these was each side of the center of the piston.

I then chucked it; setting to first one circle and then the other. The holes were first bored out a little just to see if the metal was sound, then a counterbore was sunk, slightly tapered, so as to form a dovetail. The counterbore was about ½ inch larger than the bored holes and 1/16 inch deep, or half of the piston-head thickness, which was ⅛ inch.

I then turned up two brass disks ⅛ inch thick which I beveled to fit the dovetailed counterbore and made a shrink fit.

When the piston was heated to a dull red, the disks could just be shoved into place; the large side of the disks having to be entered through the small part of the counterbores. The cast iron was supposed to shrink up and bite the disks when cooled; the dovetail not being too great to prevent this. How much it was I am not able to say, except that it was "some." Observe the ethics involved.

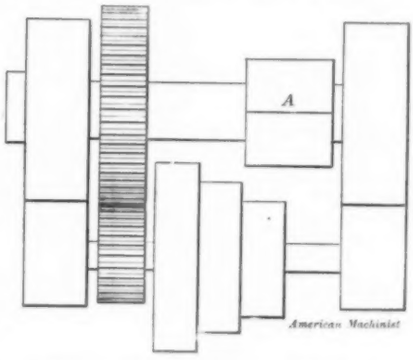
The line cut shows the job after being finished. A spare valve and valve cage completed the job and the auto is going yet.

H. K. SCHOLEFELD.

Kailua Kona, Hawaii.

Simple Speed Change for Lincoln Miller

A battery of Lincoln millers in our shop, operating on a certain line of work, stood idle a part of the time waiting for the work to come through some knee type millers. To help out, it was decided to relieve the latter machines by putting a second operation on the Lincolns—an operation requiring several times the speed the machines were bolted up for. So it looked like a case of shifting pulleys every time the change was made. However, I hit upon the better plan of using an auxiliary pulley *A* directly on the machine spindle, leaving the overhead



HIGH SPEED FOR LINCOLN MILLER

work unchanged, and simply changing over the belt.

This arrangement has proved so satisfactory and the belt can be changed so quickly that the auxiliary pulleys have become permanent and the shift is now made for as little as an hour's work. The upper feed cone is on the back gear shaft which runs much too fast when the "high speed" is thrown in—something that we offset by putting on a large pulley on the feed rod.

Middletown, N. Y. S. F. C.

Making Bronze Pinions with a Solid Feather

In our regular work we use a large number of spiral pinions made of the highest-grade phosphor bronze, and in the past have been in the habit of boring these in the regular way, keyseating them and putting in steel feathers.

This made rather an expensive and tedious job and we have been experimenting to cheapen the cost as well as improve the product and we have finally found that by using a chill we can cast a feather in and finish the hole out with a broach. This makes a better job, as a bronze feather solid with the body of the gear gives better results than a steel feather inserted.

We at first had considerable trouble with the chills sticking and tried various coatings to prevent this. We finally found that by coating the chill with shellac and knocking it out while hot, this trouble was entirely overcome.

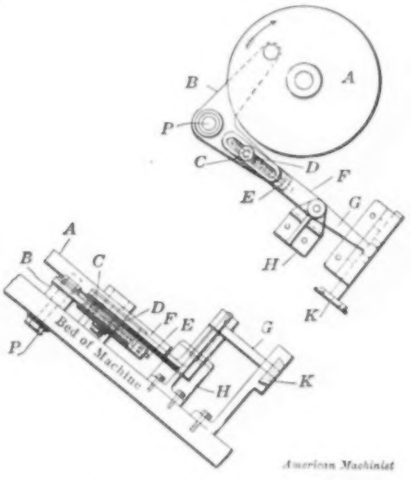
The broach is made with a pilot and the teeth are formed by cutting a thread, the tops of the teeth having practically no clearance. We, of course, cut a keyseat in the broach which trims up the sides of the feather at the same time we broach the hole. We punch these through in an ordinary arbor press and find it is necessary to allow only a couple of thousandths to get a very satisfactory hole.

Moline, Ill. WILSON P. HUNT, Sec'y. Moline Tool Co.

An Adjustable Cam Stripper

I inclose you herewith a sketch of an adjustable cam stripper, the beauty of it being that the movement is accomplished in the same time and with the same smoothness at either extreme, the longest or shortest stroke.

Another point which makes it adaptable where a crank could not be used is the fact that the cam angle is the only feature which limits its time, thereby a quick and



AN ADJUSTABLE CAM STRIPPER

even stripping motion may be obtained.

Referring to the cut, it works as follows: The rock or bell-crank lever *B*, fulcrumed at *P*, carries a roll which engages a slot in the cam *A*; one arm of the crank *B* is fitted with an adjusting screw *E* for adjusting an adjustable stud *C* in an elongated slot in the lever. The motion is given to the lever *F* by means of the sliding block *D*, which is a running fit on the stud *C*, and a sliding fit in the elongated slot in the lever *F*. The levers *F* and *G* have their fulcrum in the bracket *H*. *K* is the stripper slide and is actuated by the lever *G* through the sliding blocks shown. By making the lever *F* long enough so that the center of the block *D* might be adjusted to correspond

with the center of the stud at *P* there would be no motion to the slide *K*.

This stripper works very nicely at very high as well as on very low speeds.

Stamford, Conn. MODERN.

Order and Disorder

Why is it that some men, otherwise first-class mechanics, are always handicapped in their work by a pernicious habit of getting everything in their way? Each tool, piece of material and the very chips also, seem to be continually in the way, always in the wrong place and never in just the right place when wanted. Is this a habit, or is it negligence or a lack of foresight on the part of the workman? I am inclined to the latter belief, modified by the first, and assisted by a low state of development of the phrenological bump known as "order."

But, be this as it may, any workman can add greatly to his efficiency by taking a little thought as to where things are laid down when he is done with them. The man who "leaves his hammer hanging in the air" when the whistle blows will always be found with his bench littered with tools, piled crosswise, with samples of every kind of material he is using, and with the tool or piece of apparatus wanted next, always at the very bottom of the pile.

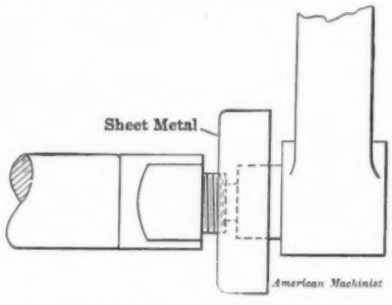
Just take a look along the bench, my friend, and see how many of the boys have this sort of thing in front of them. And then just take another look and count how many clean spots are to be found with each tool laid down straight with its neighbor and every bolt and pin so placed that it may be taken up quickly without disturbing its neighbor and without causing the loss of one minute a day in useless searching for the piece at the bottom of a pile of tools and stock.

After you have studied the above matter a few minutes, just bring the matter right home and ask yourself which kind of a mechanic stands first in the line for promotion and more pay? Which will be given preference when a responsible position opens or when a very particular piece of work is to be done? You will have no difficulty in answering the question, and if you desire to get into the better class, you do not need any correspondence course to put yourself there. Just a little thinking, and then think when you drop a tool as to where it will fall when let go.

South Bend, Ind. J. HOBART.

Chip Guard for Miller Arbors

The wear on the journal of milling-machine arbors is not lessened by the bath of chips too often bestowed by a good brush in the hands of a careless operator. To do a little foolproofing at this point is the defense of the little attachment shown in the cut. This guard is made of tin or sheet brass drawn as shown and with a hole punched in the size of the root of the threads. When screwed on, its own fit keeps it in place when it affords ample protection.



A CHIP GUARD

Middletown, N. Y. S. F. C.

To Remove Machine Shop Grime from the Hands

Take a bottle and mix in it, say, ⅓ glycerin, ¼ water, ⅛ to ¼ alcohol—nothing very exact about proportions. On no account use wood alcohol or the "denatured" brand, but straight grain alcohol. Mix well by shaking always always before using.

Before going to bed, work a quantity of this well into the skin of the hands sufficient to make them soft. Herein is the secret of success. The glycerin in the skin seems to resist the tendency of the metallic particles to cling to the skin, and it reduces the labor of washing them out with soap and brush.

If another application of the solution is made at mid-day to remain till the "wash up" at night, it will be a further advantage.

The idea is to follow up the practice day by day, not allowing the glycerin to work out.

CHARLES S. BOURNE.

Lowell, Mass.

Table of Thread Micrometer Readings

The table herewith, compiled for use with the Wells Brothers Company's thread micrometer, may be of interest to those of your readers who employ this method of thread measurement.

F. CHARLES SCRIBNER.

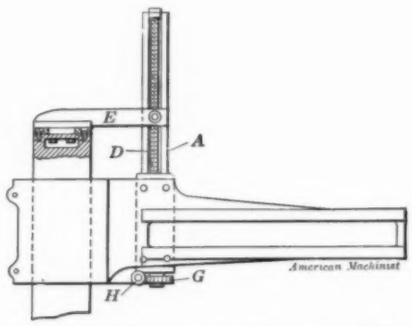
Greenfield, Mass.

Diameter.	Threads per Inch.													
	6	7	8	9	10	11	12	13	14	16	18	20	24	28
¼												0.2042	0.2169	0.2259
9/32											0.2583	0.2668	0.2794	0.2884
5/16										0.3103	0.3209	0.3293	0.3419	0.3509
11/32									0.3592	0.3728	0.3834	0.3918	0.4044	0.4134
3/8							0.4038	0.4134	0.4218	0.4353	0.4459	0.4543	0.4669	0.4759
13/32							0.4662	0.4765	0.4843	0.4978	0.5084	0.5168	0.5294	0.5384
7/16						0.5172	0.5288	0.5385	0.5468	0.5603	0.5709	0.5793	0.5919	0.6009
15/32					0.5660	0.5797	0.5913	0.6010	0.6093	0.6228	0.6334	0.6418	0.6544	0.6634
17/32					0.6284	0.6423	0.6538	0.6635	0.6718	0.6853	0.6959	0.7043	0.7169	0.7259
9/16				0.6742	0.6909	0.7048	0.7163	0.7260	0.7343	0.7478	0.7584	0.7668	0.7794	0.7884
19/32				0.7366	0.7535	0.7673	0.7788	0.7885	0.7968	0.8102	0.8209	0.8293	0.8419	0.8509
5/8			0.7781	0.7991	0.8160	0.8298	0.8413	0.8510	0.8593	0.8728	0.8834	0.8918	0.9044	0.9134
21/32			0.8406	0.8617	0.8785	0.8923	0.9038	0.9135	0.9218	0.9353	0.9459	0.9543	0.9669	0.9759
11/16		0.8760	0.9031	0.9242	0.9410	0.9548	0.9663	0.9760	0.9943	0.9978	1.0084	1.0168	1.0294	1.0384
23/32		0.9385	0.9656	0.9867	1.0035	1.0173	1.0288	1.0385	1.0468	1.0603	1.0709	1.0793	1.0919	1.1009
3/4		1.0010	1.0281	1.0492	1.0660	1.0798	1.0913	1.1010	1.1093	1.1228	1.1334	1.1418	1.1544	1.1634
25/32		1.0635	1.0906	1.1117	1.1285	1.1427	1.1538	1.1635	1.1718	1.1853	1.1959	1.2042	1.2169	1.2259
13/16		1.1260	1.1531	1.1742	1.1910	1.2048	1.2163	1.2260	1.2343	1.2478	1.2583	1.2668	1.2794	1.2884
27/32	1.1524	1.1885	1.2156	1.2367	1.2535	1.2677	1.2788	1.2885	1.2968	1.3103	1.3209	1.3293	1.3419	1.3509
7/8	1.2150	1.2510	1.2781	1.2992	1.3160	1.3298	1.3413	1.3510	1.3592	1.3728	1.3834	1.3918	1.4044	1.4134
29/32	1.2774	1.3135	1.3406	1.3617	1.3785	1.3927	1.4038	1.4135	1.4218	1.4357	1.4459	1.4543	1.4669	1.4759
15/16	1.3400	1.3760	1.4031	1.4242	1.4410	1.4548	1.4662	1.4765	1.4843	1.4978	1.5084	1.5168	1.5294	1.5384
31/32	1.4025	1.4385	1.4656	1.4867	1.5035	1.5173	1.5288	1.5385	1.5468	1.5603	1.5709	1.5793	1.5919	1.6009
1	1.5275	1.5695	1.5906	1.6117	1.6285	1.6423	1.6538	1.6635	1.6718	1.6853	1.6959	1.7043	1.7169	1.7259
1⅛	1.6525	1.6885	1.7156	1.7367	1.7535	1.7673	1.7788	1.7885	1.7968	1.8103	1.8209	1.8293	1.8419	1.8509
2	1.7775	1.8135	1.8406	1.8617	1.8785	1.8923	1.9038	1.9135	1.9218	1.9353	1.9459	1.9543	1.9669	1.9759
2⅛	1.9275	2.0635	2.0906	2.1117	2.1285	2.1427	2.1538	2.1635	2.1718	2.1853	2.1959	2.2042	2.2169	2.2259
2¼	2.2774	2.3135	2.3406	2.3617	2.3785	2.3927	2.4038	2.4135	2.4218	2.4357	2.4459	2.4543	2.4669	2.4759

WELLS BROS. CO'S. THREAD MICROMETER READINGS.
U. S. FORM OF THREAD.

Raising and Lowering Radial Drilling Machine Arms

The screw for raising and lowering the arm of a radial drilling machine, is usually placed near to the vertical column around which the radial arm swings; this position is not good; the best position being so that the center of the screw passes through the center of gravity of the arm.



DEVICE FOR RAISING AND LOWERING RADIAL DRILLER ARM

This position is impossible, as the center of gravity of the arm saddle and spindle is not stationary. The line cut shows a more correct position for the device in a medium size radial drilling machine. *A* is a cast-iron bar fastened to the back of the radial arm, in such a position that the center line of the screw *D* in the center of the bar, passes about through the center of gravity of the arm. Carried from the top of the vertical upright, round which the arm swivels, is fastened a cast-iron piece *E*, which swivels round the upright. At the end of this piece *E*, the nut is fastened, through which the screw *D* passes. The worm wheel *G* is keyed to the end of the screw *D*, and is turned by means of the worm *H*.

Manchester, Eng. W. R. O.

Blueprinting from Typewritten Copy

Several methods of typing may be used to produce copy for use as originals from which to make blueprints. Done with the ordinary violet-colored ink, the blueprints will show up but faintly, if at all. A black ribbon may be used in place of the violet, but this necessitates the trouble of making the change. Or a common "carbon copy" may be used. This has the disadvantage that the type impression is made through two sheets (white paper and carbon) and in blueprinting, the light also has a chance to diffuse between the figures on the face of the copy and the sensitive surface of the blueprint paper.

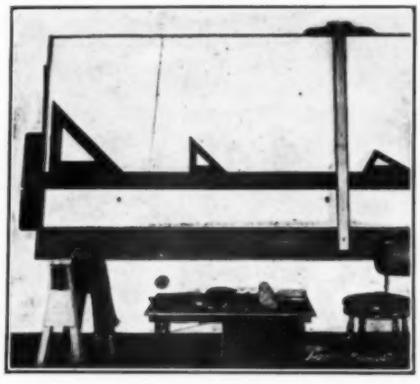
The best results are obtained by using one sheet of white paper, placed in the typewriter, and under this sheet is placed a sheet of new, black, carbon paper, with carbon surface in contact with back of white sheet. This will produce the writing on the face of the original, in the violet color while on the back of the original will be a black impression from the carbon paper.

Placed in a frame for blueprinting, this black impression lies next to the sensitized surface, giving a good, clear print.

Newburgh, N. Y. J. K. M.

Vertical Drawing Board

How a plain drawing board may be converted into an upright, universal board, from which you may derive many benefits with a very small expenditure of either time or money, is shown in the accompanying halftone. The board is a 48x144 inches, plain, pine drawing board which originally laid flat on the two horses, but is now held almost vertical by braces on the back. When flat, it was very inconvenient, because the draftsman had to walk from one side to the other when working on a large layout and could never see the true proportions of object because of angle at which it was lying.



VERTICAL DRAWING BOARD

Fasten a piece of good twine to a horizontal tee-square at point of center of gravity, pass it over top of board in a well rounded groove and hang counterweight on other side. Make groove for twine deep enough to allow vertical tee-square to pass over twine without interference, and place it about 1 inch nearer center of board than fastening point on tee-square, so that the latter has a tendency to hug the board. Fasten twine on outside surface of tee-square by means of small wood screw, so that triangles can pass between twine and board.

Now if top and end of board are square to each other, the tee-square can be worked together and you have a universal outfit.

Horizontal tee-square can be used at any angle since it is balanced.

Detroit, Mich. S. SMITH.

A Use for Bushing Ends

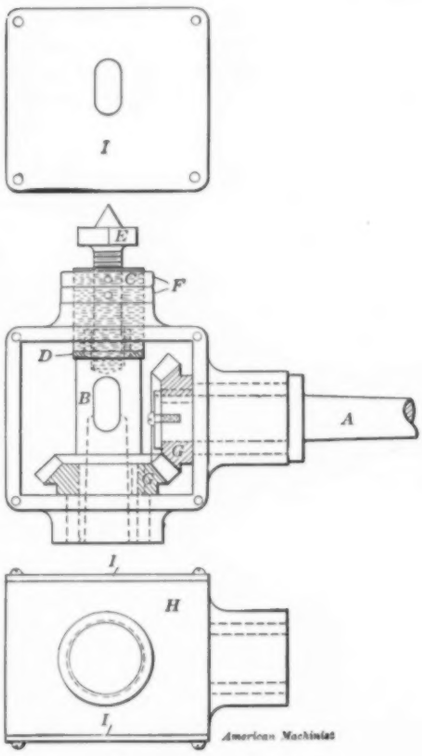
It is a good idea to save those ends which are cut off bushings, etc., having a standard sized hole or pieces with a standard female thread in them. Cut a slot in one side of them and when you want to put a dog on a piece and don't want to scar it up, slip one of your split pieces over it and place the dog on it. It will hold a lot better than a piece of brass under the dog's setscrew and the other sides of the dog will not scar the work. Another good use these pieces can be put to is when you want to run a reamer or drill into a hole a certain depth. Slip one of these pieces of correct size over your reamer the correct distance from the end to allow the reamer to go the required distance into the hole and clamp it in place by slipping a dog over it.

I have reamed a number of holes to within 0.0005 inch variation for depth on government work by using this idea.

Baltimore, Md. F. E. FICK.

An Angle Drill for Use with an Air Motor

This drilling machine was gotten up to do away with the tedious operation of a ratchet drill, which is very slow. The body *H* was made from a forging and the hole in the center slotted out, then the different bearings bored. The taper shank *A* connects with the air motor. *B* is the



THE ANGLE DRILL

spindle for the drill. *C* is the end adjustment for the spindle. *D* is a fiber washer in between the bearing and end of spindle; of course, a ball bearing would give less friction. *E* is the feed screw. *F* is the lock nut on the adjusting screw *C*. *G* are two bevel gears keyed fast to *A* and *B*; the one on *A* is also held on with a screw and washer to keep the spindle *A* from working out.

In this case the bevel gears are not miters, the ratio being about 2 to 3, the pinion being on the driving shaft *A*.

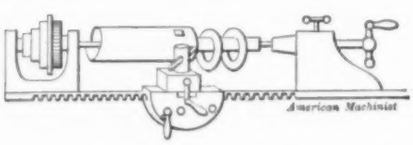
I shows the side plates, which are fastened on by four screws, and the spindle bearings in the case were bushed with brass.

Elmira, N. Y. JOHN DENSE.

Method of Turning Ring Cutters

Having had occasion to turn ring cutters out of solid tool steel 3½ inches in diameter and with a 2½-inch hole in the center we adopted the idea shown in the sketch.

First centering the stock so that it turned perfectly true, we bored into the



TURNING RING CUTTERS

end from ¼ to ½ inch and then used the cutting-off tool.

When the operation was complete and as many rings cut off as the stock would allow we still had two inches of stock on the centers.

A. L. DEMAR.

Springfield, Mass.

Bleaching Brown Print Papers

While it is quite generally known that blueprints can be written upon (bleached) by using ordinary soda water, in strength suitable to produce the desired effect, it is not so well known what will bleach brown-process papers.

While using a commercial article for this purpose in a "round writing pen" with a brass clip attached, a silvery deposit of mercury was noticed upon the brass. A solution of corrosive sublimate was then tried and found to work equally as well as the purchased article.

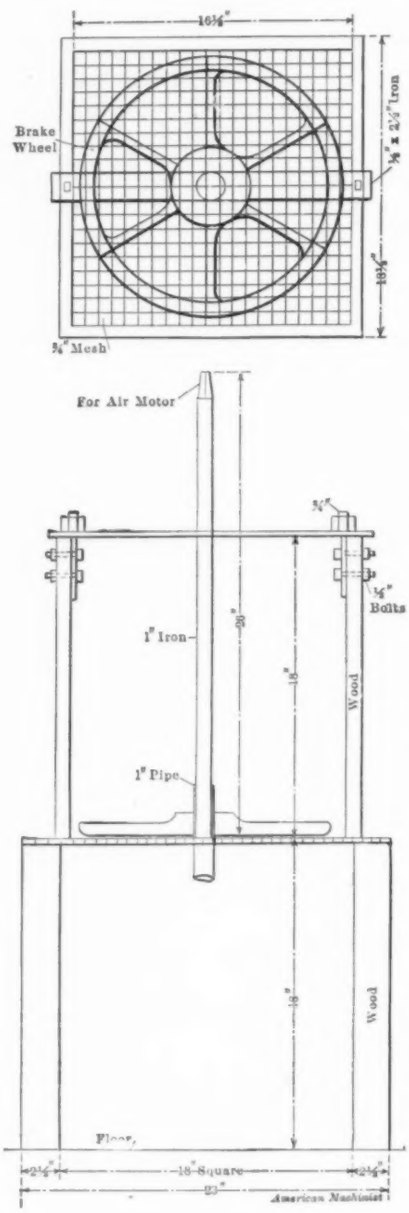
The strength of the solution can be determined by trial, increasing the amount of corrosive sublimate until the bleaching effect is produced.

Newburgh, N. Y. J. K. W.

Grinding Asbestos Lagging in Railroad Shop

A very handy and simple arrangement is shown in the accompanying sketch for grinding up the old sectional magnesia asbestos lagging for locomotive boilers.

The sectional lagging becomes broken from use and is ground as fast as one man can shovel the asbestos into the



ASBESTOS GRINDER

grinder. It is ground up fine and is mixed with water until it sticks well to the boilers it is used to cover. After applying, the steam is turned into the boiler, over night, to dry the asbestos. The jacket can then be applied at any time.

The grinding wheel is made from an old hand-brake wheel; the bottom, on which the wheel rests, is made of perforated iron ¾ inch square mesh. The bottom box is made of wood and one end is left open for shoveling out the ground asbestos. The top box, in which the asbestos is shoveled, is also made of wood. It is run by a No. 3 Imperial air motor that is direct connected to the one-inch stem of the grinder. This, too, is steadied at the top by a piece of ½x2½-inch iron.

W. H. SNYDER.

Stroudsburg, Penn.

Removing Pipe Nipples

One of the worst things the mechanic has to contend with during the erection or repair of piping for steam, water or gas, is the removal of nipples which may have proved defective. The usual method is to apply the pipe wrench to the great damage, and usually the complete destruction of the nipple thus removed. Having recently had occasion to take down and replace in a slightly different manner, some experimental piping for 150 pounds steam pressure, found that the waste of nipples was great, as scarcely one out of five close nipples would be in a condition for further use after having been removed from a fitting by means of the pipe wrench.

After spending considerable time studying the matter, a piece of tool steel of square section was procured, as large as would pass easily through the nipple to be removed. A notch was made in the steel a little deeper than the thickness of the pipe wall, and as long as the longest nipple likely to be removed with the tool. The limit is, of course, reached when there is room enough on the nipple to place a pipe wrench thereupon without damaging the thread upon either end of the nipple.

A wedge was next made with a thickness greater than the depth of the notch in the square steel. To use the device, the tool would be placed inside the nipple to be removed and hooked over the wall of the inner end. Then the wedge would be placed in the notch, and bearing against the outer end of the nipple, also against the tool. While in this position, a wrench is fitted over the tool and the wedge, the latter is tapped with a hammer to take up the lost motion, then a strong pull upon the wrench will cause the tool to tip sidewise more or less, and to engage so firmly with the nipple that slipping is impossible.

If desired, this tool, which is new, to the best of my knowledge, and not patented, may be made with a circular wedge placed outside the tool where it will always be ready when wanted, and never get lost or left behind in the shop when the tool is packed out in a hurry.

Willoughby, O. H. F. J.

The Total Cost of Production

By J. Coapman

Substituting the clock operation card for the old-fashioned time card with its pencil markings made by the workman.

Subdivision of all the different items of expense for maintenance, repairs, supplies, traveling, light, heat and power, which go to make up the overhead charge, or shop burden.

In these days of close competition, it behooves the manufacturer to look into his manufacturing costs very carefully. It is comparatively easy to find the material cost. The labor cost, however, is somewhat more difficult and yet it is much greater than the material cost. Not a few manufacturers are discontinuing the use of time cards with the labor distribution made in pencil by the workman, and substituting a clock-operation card in its place.

This card is for a semi-monthly payroll, which has many more advantages than the weekly, or bi-weekly method ever possessed. With the latter method it was practically impossible to draw off a monthly statement of the condition of the plant, because the month would overlap the four weeks. Labor at first raises many objections to this scheme, but after the first two or three pay periods they do not mind it. By using these clock-operation cards it is possible to ascertain the exact distribution of time consumed upon an order; something impossible by the old method.

On the first day of the pay period the workman finds an operation card and a payroll card. He places each of these cards in the clock and records the time of arrival, or commencement of the job. The timekeeper sees that the heading of the card is properly filled out and as long as the workman is engaged upon that particular order he records his time upon this operation card; except where the order is uncompleted at the end of the pay period, when all operation cards are withdrawn and new cards substituted.

Should it become necessary for the employee to change from one order to another, he is supplied with a new operation card. If his first job is completed he drops the operation card in the box provided near the time clock. These clocks are stationed throughout the plant so as to serve not more than 100 employees, as it has been found that in case this is not done the workmen will lose considerable time going to and from the clock. By making them record their time upon the clock in their own department, one practice prevalent in plants having but one clock is avoided; that is, the employee will register at the clock just as the last whistle is sounded, and his place of work is at considerable distance from that point.

One fact should be impressed upon their minds, and that is, the employer agrees to pay the employee for his labor at his working station, and not for time consumed in reaching or leaving that place. At the clocks are four racks, each labeled with clock numbers and a sign above distinguishing them, as: "Jobs ahead," "in payroll cards," "jobs in order," "out payroll cards" and "jobs suspended." Each rack is numbered the same. A timekeeper makes the rounds of all the clocks each day and extends the time on both the payroll cards and also the operation cards. The operation cards should balance with the payroll card. The payroll is made up from the payroll cards, while the labor costs are derived from the operation cards. So far so good.

Now comes the overhead expense, operating expense or burden, as our English contemporaries term it. The prime cost consists of the material cost plus the labor cost. Some manufacturers consider that their burden is 65 per cent. of their labor cost, others say 100 per cent. and others will use still other values. It might be well to state that the burden should not be figured on the material cost because that is practically constant; nor on the selling price because that is the total cost plus a profit, and if the burden is not known, the total cost will of necessity be unknown. The labor is liable to all sorts of changes which must be watched and as it is necessary to invest money to provide facilities for using labor to produce the manufactured article, labor should be the basis for computing the burden.

This overhead expense, or burden is made up of many different items, some fixed and others varying according to the season or other conditions. Following is a list of the many items, with their explanations:

ASSET ACCOUNTS PERTAINING TO THE MANUFACTURING DEPARTMENT

Real estate: Land only.

Buildings: This will include all buildings and plumbing in connection therewith, sewers, water pipes, etc., steam heating appliances, pipes and radiators, all electric and gas fixtures or appliances, the sprinkler system, including all pipes, tanks and pumps, and elevators.

Equipment: This includes boilers, engines, dynamos, motors, machines, machine tools, line shafting and hangers, belting, chain hoists, pulleys, etc., standard jigs and dies, transportation equipment, such as; service cars, horses and rigs, if any, etc.

Miscellaneous equipment, or portable tools:

Cutting tools, files, hammers, wrenches, drills, trucks, barrows, etc.

Shop fixtures and fittings: This will include such items as benches, cupboards, chairs, desks, lockers, partitions, shop trucks, tool racks and fire apparatus. These are items, as distinguished from machinery, tools, etc., included in equipment account.

Factory office furniture and fittings.

General office furniture and fittings.

Patterns.

General stores.

Work in progress.

Finished stores.

Cost of completed article, from assembling.

Cost of parts, drawn from finished stores.

Repairing finished articles as per repair orders.

MANUFACTURING EXPENSE ACCOUNTS

Supplied from general accounting office, either in whole or in part.

Note: Pro-rata monthly on taxes, insurance and such items as may not be paid regularly each month.

Rent.

Taxes.

Water.

Fire insurance.

Employers' liability insurance.

Time service; Western Union clock service.

Still alarm.

Entertaining.

Miscellaneous freight and cartage.

Factory advertising.

Traveling expense (other than for selling purposes).

Gas account, and repairs to gas appliances.

Heat, light and power; for coal and light bills.

Fixed non-productive salaries.

MANUFACTURING EXPENSE ACCOUNTS

Supplied from manufacturing department on monthly statement. Maintenance of buildings.

Repairs to equipment: All repairs for maintenance of machinery, machine tools,

etc., and repairs to all such items as go into equipment account.

Perishable tools: Cutting tools, files, hammers, wrenches, drills, trucks, barrows, etc.

Repairing and replacing tools.

Drawings and tracings.

Replacing drawings and tracings.

Repairing and replacing patterns.

Spoiled work.

Factory and factory office stationery and supplies.

Crating and packing supplies and labor.

Non-productive labor.

Messenger service: Maintenance of cars, horses, and drivers' time.

Extra rate for overtime.

Supplies for various departments.

Electrical repairs; supplies, repairing and time.

Labor spent on defective material.

Heat, light and power: Supplies, labor, etc.

Gas account and repairs to gas appliances: Supplies, repairing and time.

GENERAL EXPENSE ACCOUNTS

Supplied from the manufacturing department on monthly statement.

General office stationery and supplies.

Each department is given a number to which all supplies for that department should be charged. For a very large plant we might need up to 100 numbers for departments in operation. It would seem advisable to leave possibly 25 additional numbers for new departments. It could then start a series of standing shop orders to cover the other items, viz.:

No.

150. Non-productive labor.
151. Perishable tools.
152. Miscellaneous experimental work.
153. Spoiled work.
154. Maintenance of buildings.
155. Electrical repairs.
156. Factory, and factory office stationery and supplies.
157. Repairing and replacing tools.
158. Replacing drawings and tracings.
159. Repairing and replacing patterns.
160. Crating and packing supplies and labor.
161. Messenger car service: Maintenance of cars, horses and drivers' time.
162. Labor spent on defective brass castings.
163. Labor spent on defective bronze castings.
164. Labor spent on defective aluminum castings.
165. Labor spent on defective steel forgings.
166. Labor spent on defective steel castings.
167. Labor spent on defective steel stampings.
168. Labor spent on defective iron castings.
169. Heat, light and power.
170. Repairs to gas appliances.
171. General office stationery and supplies.
172. Repairs to factory office furniture and fittings.
173. Repairs to general office furniture and fittings.
174. Factory fixtures and fittings.
175. Portable tools.
176. Electrical appliances.
177. Factory office furniture and fittings.
178. Factory fixtures and fittings.
179. General office furniture and fittings.
180. Parts in progress of manufacture.
181. Gas appliances and fittings.
182. Foundry parts in progress.
183. Forge shop parts in progress.
184. Stamping parts in progress.

The monthly statement should show the exact amount of money invested in each of these items.

By keeping the exact labor cost of each order it is possible to determine the total productive hours and the labor cost of same. The manufacturing expense statement will show the total expense. This amount divided by the number of productive hours will give the burden per hour, or if the manufacturing expense is divided by the productive labor cost, the percentage of overhead, or burden can readily be found.

If these lines are followed the manager can put his hand upon any and all leaks in a very short time, and will be able to act intelligently. It should not require over two weeks to prepare this statement in any plant under 2500 employees with a well equipped cost department, and the expense will be amply repaid both in money saved and in the exact knowledge of the physical condition of the plant at all times.

Two Ways of Treating Help

By Con Wise

Quite a number of the world's inhabitants work for a living. Some work without apparently getting a living, and some work long after it seems as if they might stop and let the rest of us divide it among us. Being in a cynical mood, I wish to say that these people all work for one of two reasons—one, that they are driven to it; the other because they are led into it.

One of the hardest working men that I ever knew told me repeatedly that he would naturally have been lazy, but that he was led into one thing after another, and so controlled by circumstances that he was forced to work. Here was a man under both influences, with remarkable results.

We all know men who have worked for wages and never taken the slightest interest in their employer's welfare, who have gone into business and turned over and worked night and day. Why? Because they were driven by their necessities; first, to make money, and then to keep it. For it is certain that it is harder to stay in business and keep one's capital intact, than it is to make the capital to begin with.

Now the question is: "Which is the best management; to drive your help to work, or to lead them?"

Here is one man, whose men are afraid of him; whose employees never know whether their jobs are secure or not. He gets out the work. There is something hypnotic about him. He can always get help. He seldom holds them long, but while they stay he squeezes every ounce of work out of them. He is known as a "slave driver" all over town, despised but successful, because he makes things go.

On the other hand, there is the man who gets results by leading his men. When his shop was small, he did more work than any of his men could handle. When it grew large, he paid top wages and drew the best men the town afforded. To be sure, after they had been with him a while they slowed down. Their production was not nearly up to their previous mark, but by that time he had secured the cream of the business and he could afford to let them slow down. When competition began to make itself felt, instead of putting on the screws and driving his men, he put in the premium plan and led them to beat their past records.

There is no question which of the two we would rather work for, but we do, in large numbers, continue to work for the driver. I cannot see why, because it is against our common sense and our pocketbooks; unless it is because there is something exciting in continually running with the safety valve blowing off, and eternally racing from one week's end to another. The driver gives us excitement, and plenty of it; the leader takes the excitement himself, and gives us the money.

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E.C., will serve all subscriptions for English Edition for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Published in the German language under the name of "Maschinenbau," by the Hill Publishing Co., m. b. H., 71 Unter den Linden, Berlin, N. W. 7. Price for Germany 24 M., Austria 29 K., Switzerland 32 Fr., other countries in Eastern Hemisphere 35 M., North or South America 40 M., or $10.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1909, 1,209,000 *copies. For August,* 1910 *(American weekly, American monthly, English weekly and German weekly), total,* 117,250.

September 1	41,500
September 8	25,250
September 15	25,250
September 22	25,500
September 29	25,750

None sent free regularly, no returns from news companies, no back numbers.

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American Machinist

Editorial

How Far is Cheapness a Factor in Sales?

It is a prevalent notion among designers of machinery that to sell well a thing must be simple and cheap. While it is no doubt true that, other things being equal, the cheaper of two competing things will get the most of the market, the broader fact is that things will sell at almost any price provided they are worth it.

The most simple of timepieces were the sun dial and the hour glass, but notwithstanding this, clocks and watches are sold by the million, at prices ranging up to a thousand dollars and more.

Fifty or sixty years ago the inventors of a certain city went daffy on door springs. One among them made a spring worth a dollar and a half, which the others thought altogether too much, each one in succession cutting down the price until they got to 25 cents—and no one made any money on door springs. A few years later someone invented a spring which sold for and was worth twelve dollars and they are still being made and sold by the thousand.

In a recent history of the origin and growth of the typewriter business, mention was made of the work of Mr. Pratt, of Georgia. Mr. Pratt was at one time engaged in the attempt to raise capital for the manufacture of his invention in England, and he held the opinion that if his machine could not be sold for two pounds there or ten dollars in this country, nothing could be done with it. Mr. Pratt had produced a workable typewriter that did good work, and one that could be sold at the price he had fixed. What his later history was we do not know, but it certainly was not a large one and the fact remains that the Remington $125 machine sold from the start, and out of the invention great industries have been built up.

The automobile is another case in point. We all remember the little runabouts of the "horseless carriage" days and their prices of a few hundred dollars. Certainly these machines found a market, but nevertheless the automobile did not come to its own until machines priced at $4000 and upward made their appearance, and these machines sold because they were worth the prices asked. The present sale is, of course, chiefly of machines at much lower prices, but the fact remains that it was the high-priced machine that made a success of the automobile business.

A Hazard in Manufacturing

The ups and downs of business—prosperity and panic—are recognized as one of the hazards of manufacturing. But there is another hazard that is not as generally foreseen, especially by persons outside of manufacturing pursuits; nevertheless it is one that is a constant menace in many lines of industry. It lies in the possibility that new inventions or broader developments may sweep away the entire demand for a product that has been manufactured successfully for many years. This hazard gives rise to the tremendous amount of development work that is so actively carried on by many large firms.

The reality of this hazard in manufacturing has been clearly shown to us during a visit to many of the more important machinery-building firms of Europe. In America the reciprocating steam engine is by no means a thing of the past. In Europe we were in but two shops that were building reciprocating steam engines and these were of comparatively small size. On the other hand steam-turbine building was met with almost everywhere.

One of the best known engines of England was the Willans. Today the Willans & Robinson plant is building steam turbines and Diesel oil engines.

On the Continent the Sulzer engine was one of the foremost and in fact it was the envy of many American engine builders because of the excellence of its workmanship. In the great Sulzer plant at Winterthur, Switzerland, only one reciprocating engine was seen and that was of comparatively small size and had experimental features.

The steam turbine has apparently driven the reciprocating steam engine from the European field and now active experimentation is being carried on with the gas turbine, as a possible further development which may have decided advantages over the steam turbine.

Thus mehanical developments and inventions are a real hazard in manufacturing as well as changing economic conditions. May it not be worth while at times to stop and ask: Is my business of such

a nature that I am free from such hazards? And if not, am I taking proper safeguards against them?

Death of Dr. Isidor Loewe

On the thirty-first of August Geheimrat Doktor Ingenieur Isidor Loewe was borne to his grave; with him passed away one of the most important and able of the large manufacturers of Germany. He is perhaps best known through his connection with the machine-tool building firm of Ludwig Loewe & Co., of Berlin.

In 1886, when about 37 years of age, and after the death of his brother Ludwig, he undertook the sole leadership of the joint-stock company of Ludwig Loewe & Co. This firm was originally engaged in the manufacture of sewing machines, for which purpose a factory had been erected along American lines. Later it developed into the construction of machine tools, which it still carries on on an extensive scale. In this connection German industry owes him a great debt for his unfailing attitude in urging upon German manufacturers the use of precision machinery.

Two years after the death of his brother Ludwig, he took up the manufacture of small-caliber arms and ammunition, having secured the greater part of the capital stock of the celebrated Mauser Arms factory at Oberndorf. From this beginning developed the important German small-arms and ammunition factory, occupying an immense plant near the Loewe machine-tool plant.

In 1898 another undertaking was launched in the German Niles Tool Works, devoted to the building of heavy machine tools.

In 1892, Dr. Loewe entered the electrical industry. He founded, in connection with the Thompson-Houston Electric Company, the Union Electric Company—the U. E. G. In the following year a company for electrical enterprises was established. While the Loewe company carried on the manufacturing end of the business, the U. E. G. company handled the financiering. In 1903 this company was absorbed by the Allgemeine Elektricitats Gesellschaft. After this union, however, Dr. Loewe continued to maintain an important position in its management.

Among other companies with whose control Dr. Loewe was connected are the Koln-Rottweiler Powder Factory, the Duren Metal Ware Factory, whose chief products are cartridge material; Bohler Bros. & Co., Inc., and the Iron Foundry Company, formerly Keyling & Thomas. In all, he held some 27 directorates.

Geheimrat Loewe was a type of the energetic German industrial leader. He was equipped with a keen intelligence and forceful spirit. He united to an unusual degree technical endowments with business initiative. Along with his commercial interest he had a sense for all the important phenomena of the age. He was an enthusiastic promoter of aviation. In the next to the last voyage of the subsequently destroyed airship "Deutschland" he was a passenger.

DR. ISADOR LOEWE

Along social lines he was always working for peace and harmony, and many a bright young man owes much to Dr. Loewe for the encouragement that he received, always given in a judicious but generous manner.

Alexander Gordon

Colonel Alexander Gordon, chairman of the board of directors of the Niles-Bement-Pond Company, died at London, England, September 11, where he was sojourning in the search of renewed health.

Colonel Gordon was a native of Belfast, Ireland, born in 1839, and when a young man decided to cast his fortunes in this country. In the early sixties, he with his brother Frederick, conducted a machine shop in Ironton, Ohio, and a few years later, in association with G. A. Gray, the founder of the present G. A. Gray Company, enlisted sufficient capital to purchase a well established machine shop in Cincinnati, operated by John S. Niles. For four years his business prospered, when in 1871 the site on which it was built was required to make way for the Pennsylvania railroad depot.

A large tract of land in Hamilton, Ohio, was secured for the establishment of a new and enlarged plant, which was put in operation in 1872, under the name of the Niles Tool Works Company, with Colonel Gordon as president. In this position the Colonel became a prominent figure in the machine-tool industry, and brought to the business of his company a marked growth

In 1887 G. A. Gray retired from the firm, and soon after Colonel R. C. McKinney, now president of the Niles-Bement-Pond Company, joined the enterprise as secretary.

PERSONALS*

Jethro Baker has been appointed general superintendent of the Fales & Jenks Machine Company, Pawtucket, R. I.

F. Küppersbusch, of Küppersbusch Sohn Schalke, Germany, is at present in this country on a tour of inspection of the leading foundries.

Joseph Monforts, of Engr. Michels Maschinenfabrik A. Monforts, is at present in this country looking into textile machinery developments.

Hugh A. Brown has been appointed manager of the Chicago office of the Garwood Electric Company, with offices in the Old Colony building.

Harry Z. Bixler, formerly in the employ of Worth Bros. Company, Coatesville, Penn., has been appointed chief engineer of the Youngstown Steel Company, Youngstown, Ohio.

Earle J. Banta, formerly chief engineer of the Cincinnati Equipment Company, Cincinnati, Ohio, has become connected with the Vulcan Steam Shovel Company, Toledo, Ohio., to act in a similar capacity.

C. L. Gulick has resigned as vice-president of the American and British Manfacturing Company, Bridgeport, Conn., to accept position of vice-president and general manager of Enos Company, of New York City.

Joseph Breslove, until recently in the engineering department of the Westinghouse Machine Company, East Pittsburg, Penn., has accepted the position of mechanical engineer of the Nivison-Weiskopf Company, Cincinnati, Ohio.

Frank A. Stanley, for a number of years a member of our editorial staff, has been appointed western editor of the AMERICAN MACHINIST, and will be permanently located in that territory, with headquarters in Cincinnati, Ohio.

H. Struckmann, formerly chief engineer and general manager of the Union Sand and Material Company, St. Louis, Mo., has accepted the position of chief engineer and general manager of the Iola Portland Cement Company., Iola, Kan.

J. C. Whiteside, recently with the Morgan Engineering Company, Alliance, Ohio, has become connected with the New York Leather Belting Company, New York, in the capacity of manager of publicity, and will have charge of the advertising and engineering, as well as publishing their belt engineering monthly "Phoenix."

*Items for this column are solicited.

New Tools and Shop Appliances

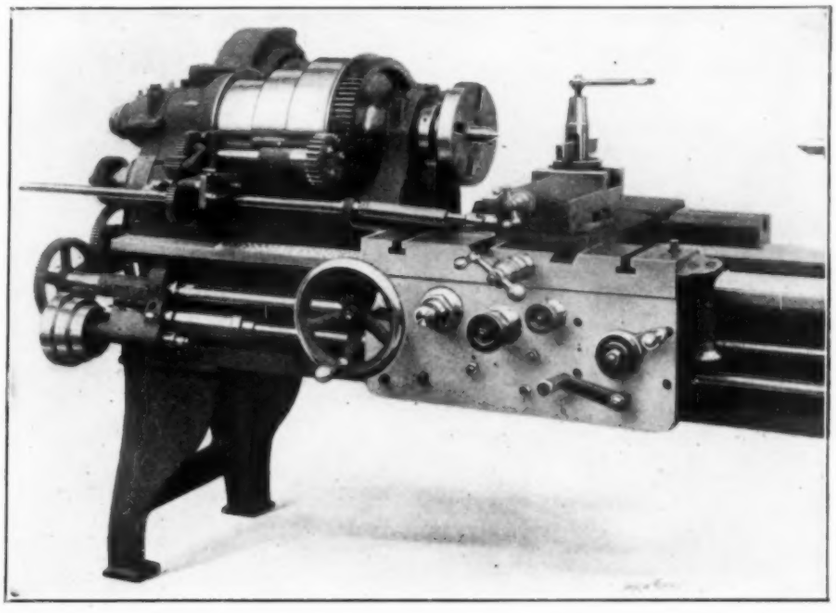
The Bradford Relieving Attachment

The relieving attachment here illustrated is made by the Bradford Machine Tool Company, Cincinnati, O., and is now furnished with their 14-, 16-, 18-, heavy pattern, 20- and 22-inch lathes but can be had with other sizes if ordered. It can be used in conjunction with their taper attachment and will relieve straight or taper work of any number of flutes from 2 to 24 inclusive.

A substantial bracket is built as a unit with all parts self-contained, thus insuring the permanent alinement and correct coaction of the parts. This bracket with its parts is mounted in front on the headstock where it is easily accessible. The attachment is driven by a spur gear meshing with the face gear, thus avoiding abnormal gear ratios and small driven pinions or a multiplicity of gear centers to provide for the 2 to 24 movements per revolution of the spindle. A single fixed cam is mounted on a shaft of large diameter and close to the shaft bearing, providing that rigidity which is so essential to a device of this kind. This cam actuates one arm of a lever through a roller on a tool-steel stud. The roller being fixed in position on the lever, receives correct movement at all times. In this attachment the amount of relief is obtained in the following manner. The motion of the roller is transmitted through the rocking lever and connecting rod to the rock shaft. One end of the connecting rod is attached to a sliding block capable of adjustment to and from the center of the rocking lever. This adjustment controls the amount of motion to be transmitted to the rock shaft and is obtained by means of a screw and nurled knob placed within easy reach of the operator. The amount of relief is quickly adjusted without stopping the lathe.

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.



THE BRADFORD RELIEVING ATTACHMENT

A bracket on the carriage carries one end of the rock shaft and the movement of the rock shaft is transmitted through a telescopic sleeve and shaft and knuckle joints to a set of spur gears in the compound rest. On the side of one of these gears is an eccentric hub which engages the bronze nut in the compound rest through which, in turn, passes the top slide screw. The movement of the rock shaft is transmitted through the telescopic sleeve shaft and knuckles and eccentric gear and screw to the top slide of the compound rest and it will be readily seen that a rocking movement will result in the compound-rest top slide. A set of change gears and an index plate are furnished.

The gear which meshes into the face gear is adjustably fixed to a flange which is keyed to the shaft, thus providing an adjustment between the tool and the work in first setting up without disconnecting.

The carriage of the lathe has full traverse between centers and the movements of the compound rest are always available. The attachment need not be removed when doing ordinary work, as simply locking the small quadrant of the attachment up or down respectively disengages or engages it.

Gear guards are placed over all exposed gears and are arranged so that they can be readily removed when necessary.

The tool is quickly withdrawn from the work by a strong spring capable of ready adjustment with nut and washer.

One of the novel features of this attachment is found in the connecting means between the connecting rod and the rock shaft which facilitates the easy lengthwise movement of the rock shaft even on coarse pitch taps, etc., and heavy cuts. The crank is fast to an inner sleeve and is driven by an outer bush. The sleeve drives the rock shaft through a key, but is capable of an automatic limited movement lengthwise with the rock shaft independent of its driving connection with it, a strong spring returning it to its original position after each cut. This construction effectively overcomes any tendency of sticking or binding of the rock shaft.

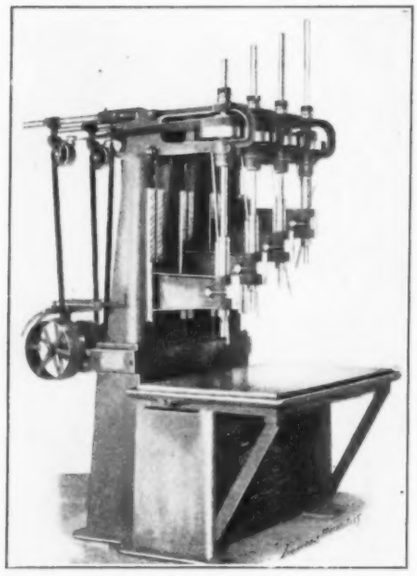
A Single-action Open-back Power Press

The La Salle Machine and Tool Company, La Salle, Ill., has just put on the market a heavy No. 4 open-back power press. There has been no radical change in the construction, the object in view having been to produce a plain, strong, durable press. The machine weighs 2300

pounds, has a stroke of 3 inches, measures 9 inches between uprights and has a 5-inch hole through the bed.

The Henry & Wright Cabinet Base Drilling Machine

The halftone shows a further development in the line of a ball-bearing, high-speed drilling machine of particular interest to the larger manufacturers where economy in the smallest details means a tremendous total on account of the extremely large number of similar operations that are constantly performed. As shown by the illustration of the No. 4 machine, the table is not adjustable, but is fastened to the cabinet base in a way to make it rigid and immovable in service, but it may by removing four screws be taken off for redressing to renew its accuracy. The same large drilling heads used in the automobile manufacturers' drilling machines, described on page 370 are used on this type, and the combination is extremely rigid and unyielding. The table is ribbed on the under side like a standard surface plate, and it is made extra heavy to provide for redressing. Four oil ducts fitted with strainers, convey oil from the table to a tank inside the base.



HENRY & WRIGHT CABINET BASE DRILLING MACHINE

The machine will drive high-speed steel drills up to 1⅛ inches in diameter but its most efficient field of operation is the drilling of holes ⅞ inch and under; the extra power being intended to drill the occasional larger hole which may occur in a piece of work full of small holes. As will be readily seen, this arrangement much increases the working range of the machines, as a large number of parts that would either have to be drilled, tapped, counterbored or reamed in two or more machines may frequently be done on one of these machines without removing the part from the jig, which tends toward greater interchangeability, accuracy, economy and rapidity in manufacturing.

The hole in the spindle is No. 2 Morse taper so that it will be necessary to reduce the taper of the largest drills in order to make them fit the spindle. This is the first machine of this type produced, but it is the intention to make it in other sizes.

The machines will be furnished with plain tables, or with full oiling equipment, including tank, pump, piping, flexible tubing and faucets as ordered.

The makers of these machines are the Henry & Wright Manufacturing Company, Hartford, Conn.

Diamond Grinding Machinery

The accompanying illustrations show some of the grinding machinery which has been redesigned by the Diamond Machine Company, Providence, R. I. Fig. 1 shows an inclosed-head polishing machine with the belt underneath and a portion of the frame broken away to show how the belt is shifted from the tight to the loose pulleys. This is instead of an idler or other means of tightening the belt to throw it into action. The shifting of the belt, which is 4 inches wide, is controlled by the small handle which projects in front of the frame so as to be easily accessible to the operator.

FIG. 1. INCLOSED HEAD POLISHING MACHINE

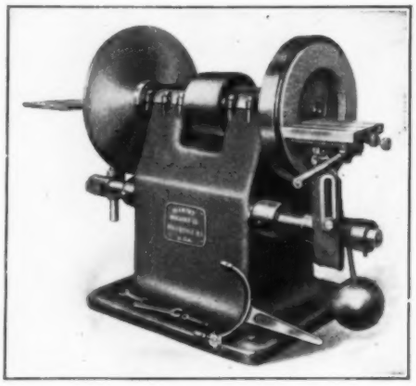
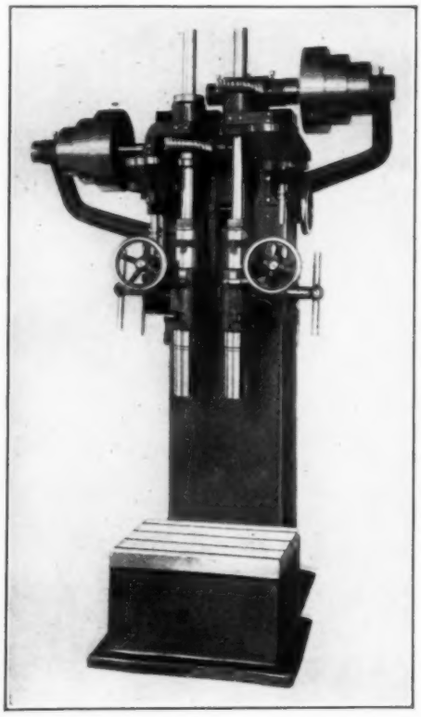


FIG. 2. IMPROVED DISK GRINDER

Fig. 2 shows the improved form of disk grinder, in which one disk has been replaced by a ring wheel. These grinders are supplied with 30-inch steel disks, with one disk and a 22-inch ring wheel as shown, or with both ring wheels if preferred. These ring wheels are held in a steel-bound adjustable chuck, and are driven by an 8-inch belt. The tables are extra large, or a swinging table, as shown in front of the ring wheel, can be provided as desired.

A Drilling, Boring, Facing and Tapping Machine

The Hoefer Manufacturing Company, Freeport, Illinois, has placed on the market the two-spindle machine shown in the halftone, especially adapted for drilling, boring, counterboring and tapping.



A DRILLING, BORING, FACING AND TAPPING MACHINE

The column is of the box type, to which a stationary base is attached. On the upper end of the column is attached a gib cross rail, to which the two spindle heads are gibbed. The spindle head to the right is permanently fastened on the cross rail. The spindle head to the left is horizontally adjustable on the cross rail by means of a screw, so that centers of various distance may be obtained.

The spindles are driven by three-step

cones through steel worms and bronze worm gears. The worms are supplied with ball-bearing end thrusts and run in an oil bath. The feed is positive geared and can be automatically tripped at any predetermined point. Each spindle is driven and fed independently of the other.

The feed gears have four independent changes. The spindles have also a hand feed and a quick return lever. The feed changes are obtained by a lever in convenient reach and which swings against an index plate, giving the desired feeds in thousandths.

For tapping, the necessary gearings will be supplied for the lead required for the tap, so that there is no stripping of the threads.

This machine requires 30x45 inches floor space. A countershaft is furnished with it.

Robey-Smith Automatic Bevel Gear Planer

In the Robey-Smith automatic bevel-gear planer the advantage claimed is that there are no cams or formers used, the shaping of the teeth being secured and controlled by the adjustment of four indexed quadrants.

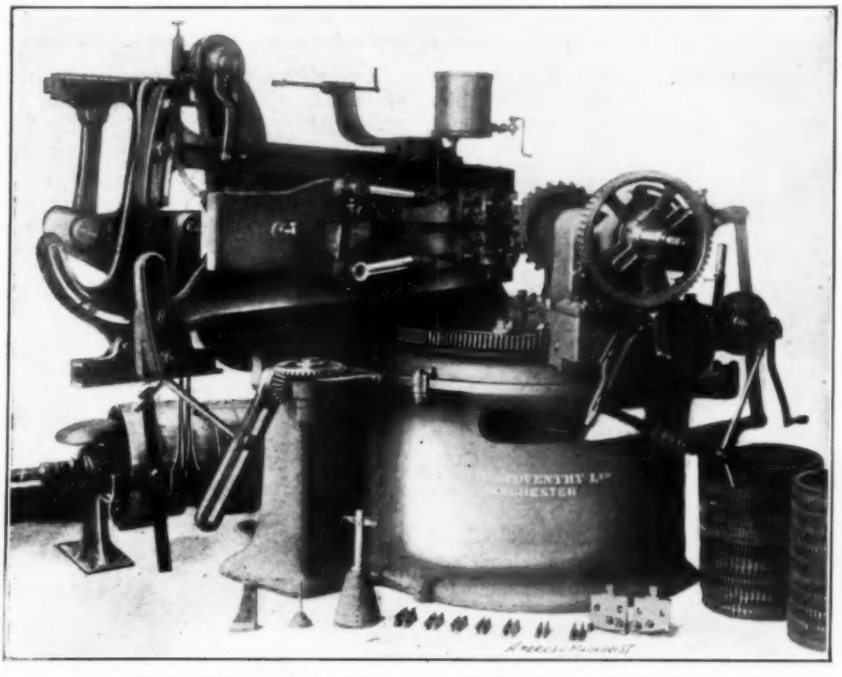


FIG. 1. ROBEY-SMITH AUTOMATIC BEVEL-GEAR PLANER

The bevel-gear blank to be cut is mounted upon the spindle, as shown in the illustration, Fig. 1, and the two shaper arms, whose angularity is controlled by the indexed quadrants, travel back and forth to shape the teeth. Cutting occurs on both tooth faces at the same time. Between each two strokes of the cutting tools the gear blank is automatically rotated one tooth, thus avoiding local heating and consequent distortion of the metal.

Feeding is accomplished by automatically swinging the spindle carrying the gear blank, in a horizontal plane, the center of this rotary motion being directly under the apex of the blank to be cut. As this motion progresses, the angularity of the shaper-arm travel is automatically changed, to suit the tooth outline. Stops are provided to determine the proper depth of tooth. Indexes are provided at all points where adjustment is to be made, so that little skill is demanded of the workman.

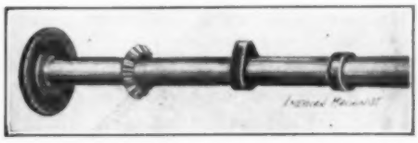


FIG. 2. EXAMPLE OF BEVEL GEAR FORGED ON LONG SHAFT, CUT IN GEAR PLANER

Twenty-one dividing plates are supplied for all numbers up to 50, also for 24 other important numbers up to and including 120. These plates are made with two separate sets of notches, one set for rotating the plate, and the other set for dividing only.

Spindle is of large diameter with a hole entirely through the center for reception of mandrels, or specially long bosses or shafts, found in motor-car work, one of which is illustrated in Fig. 2. An outer support is also provided for carrying the end of the mandrel for extra stiffness.

With machines numerous gages are furnished for setting the tools and blanks in position. Eight pairs of high-speed cutting tools are also furnished. If desired, one pair of tool boxes, holders and tools may be supplied as extras for cutting internal gears.

This machine is sold by Schuchardt & Schütte, corner West and Cedar streets, New York City.

Handy Diestock

This tool is of compact construction and is manufactured in the lightest form practicable.

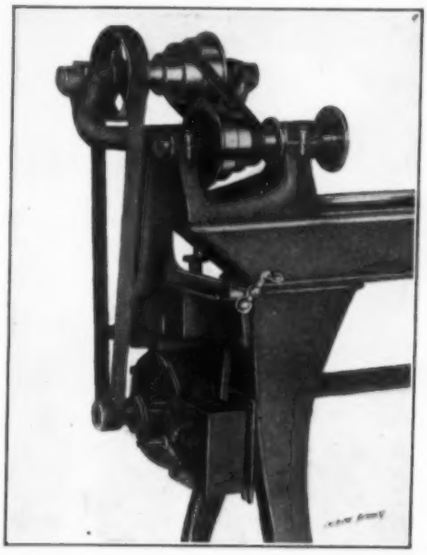
It is self-contained, requiring no bushings, wrenches, etc., and has no leader screw. It is so designed as to avoid all slippage while cutting, and is made in four sizes, for pipe ranging from ¼ to 2 inches, threading both right and left hand.

HANDY DIESTOCK

These tools are manufactured by the Handy Manufacturing Company, 71 W. Broadway, New York City.

Electric Motor Drive for the Seneca Falls Speed Lathe

The halftone shows the electric motor drive as applied to their speed lathes by the Seneca Falls Manufacturing Com-



ELECTRIC MOTOR DRIVE FOR THE SENECA FALLS SPEED LATHE

pany, 687 Water street, Seneca Falls, N. Y.

The upright countershaft frame is hinged on a bracket attached to the leg. The cone belt is tightened by turning the hand crank on the bracket. The belt from the motor is tightened by the hand nut and both belts can be kept at the proper tension until worn out without shortening. The bearings of the countershaft have oil rings the same as the head-spindle bearings of the lathe.

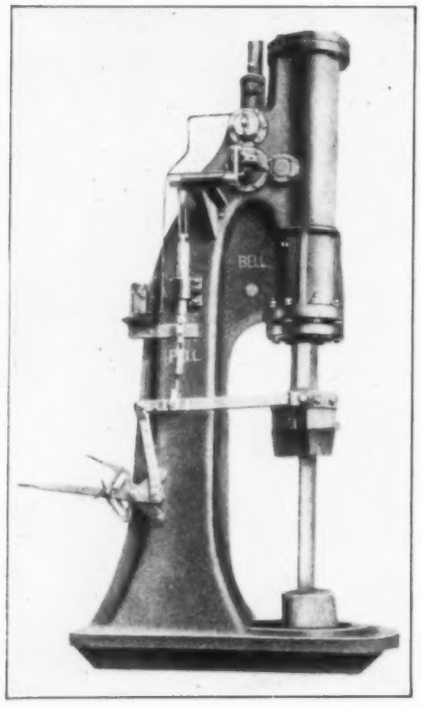
The advantage of this type of drive is that any constant-speed motor ½ or ¾ horsepower may be used, but a variable-speed motor may be used if desired and will be found desirable on some classes of work.

The Bell Steam or Air Hammer

The halftone shows a Bell steam or air hammer built by the Buffalo Foundry and Machine Company, Buffalo, N. Y.

The valve gears of the two larger sizes of these hammers have recently been redesigned, the oscillating valve formerly used having been replaced by a balanced piston valve.

The changes made have not involved the changing of the pattern or general appearance of the hammers. These hammers are made in four sizes, the weights of the falling parts being respectively



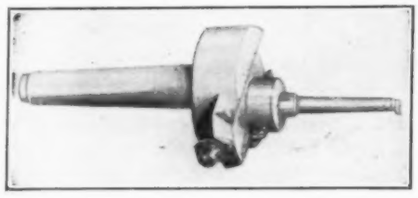
BELL OPEN FRAME STEAM OR AIR HAMMER

250, 450, 700 and 1500 pounds, with cylinders 6, 8, 10 and 12 inches diameter.

These hammers can be operated with air under pressure in which case there is no loss from condensation as with steam.

An Adjustable Boring Tool Holder

The line cut shows an adjustable boring tool holder which is being put on the market by the Grant Manufacturing and Machine Company, Bridgeport, Conn.



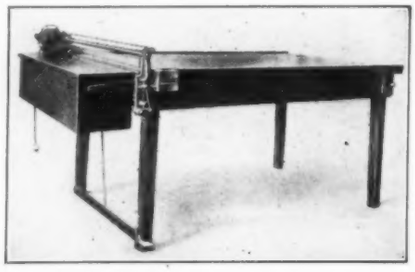
ADJUSTABLE BORING TOOL HOLDER

The tool is intended principally for work on the miller, the taper shank fitting the milling spindle.

Adjustment of the tool to or from the center is obtained by the graduated adjusting screw which reads to thousandths.

A Motor Driven Blueprint Paper Cutting and Trimming Table

The accompanying illustration shows a motor-driven cutting and trimming table, arranged with a light-proof box for blue-



A MOTOR DRIVEN BLUEPRINT PAPER CUTTING AND TRIMMING TABLE

print paper. This trimming table will be found convenient by makers of blueprints, and it can also be used to advantage for cutting tracing paper or cloth, detail paper, etc.

This table is provided with a parallel clamp, operated with a foot treadle which holds the paper, tracing cloth or print securely while the revolving cutting knife is used. This device will trim a very narrow strip from the paper or print.

The revolving cutting knife is motor driven, and is rotated positively by mechanical means not depending upon friction against blade or paper, and therefore, will cut the thinnest paper perfectly. Will also cut five to ten sheets at once.

The table is constructed of hardwood with metal trimmings, arranged to be easily knocked down for shipment. Electric equipment is complete and arranged so it can be connected to any incandescent light socket.

The top of the table is scored in inches, and is provided with figures along the front edge, so that any size sheet can be instantly cut. A sizing diagram can also be provided for the top of the table, which gives at a glance the size of any tracing or print and the square foot measurement, no calculation being necessary.

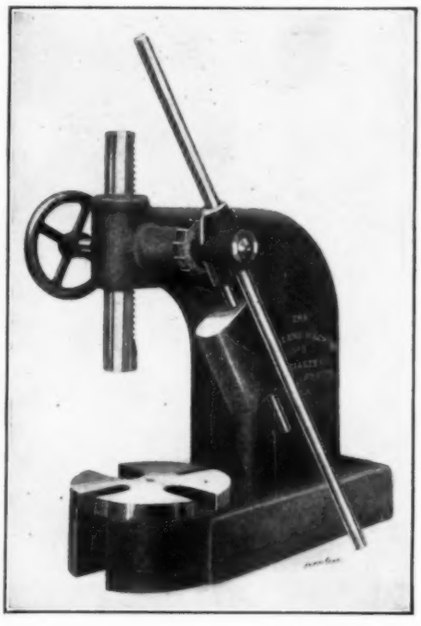
These tables are also furnished with a basket on the end, instead of a light-proof box, especially designed for cutting prints after they have been run in an automatic continuous printing, washing and drying equipment. The tables as regularly furnished are 4 feet wide by 6 feet long, but any width table up to 8 feet wide can be supplied. This table is also furnished in widths up to 42 inches wide, arranged for operating the cutting knife by hand, instead of with mtoor. The cutting machinery is all self contained, and can be furnished separately if desired, so it can be bolted on any table of appropriate width, and the cutting device can be used with or without the parallel clamp as desired.

It is made by the C. F. Pease Company, 167 Adams street, Chicago, Ill.

A Heavy Arbor Press

The halftone shows a new heavy arbor press recently put on the market by the Cleveland Machine Specialty Company, Cleveland, O.

The frame is of box construction with a base 5½ inches high and heavily ribbed to the full depth of the frame. The lever is counterweighted and when released,



A HEAVY ARBOR PRESS

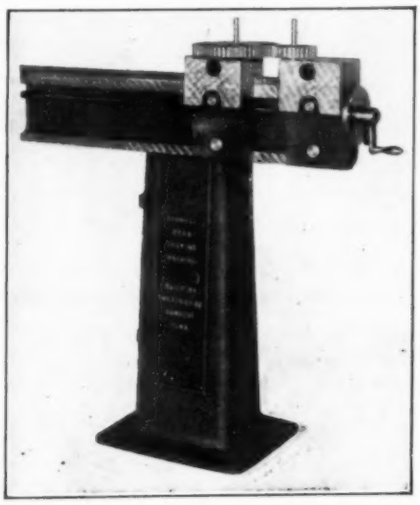
rises to the vertical position at which point the pawl is automatically raised from the ratchet wheel so that the ram can be quickly adjusted to or from the work by means of the handwheel.

The machine will take work 20 inches in diameter by 15 inches high, will press a 3-inch arbor and exert a pressure of six tons. The machine weighs 430 pounds net and is designed to withstand the abuse to which these machines are so often subjected.

Gear Testing Machine

The accompanying photograph shows the new Farwell gear-testing machine, a recent product of the Adams Company, Dubuque, Iowa.

The machine is designed for testing spur gears in sizes up to 30 inches be-



GEAR TESTING MACHINE

tween centers, and shows any inaccuracy in diameter or depth of teeth as well as detecting skew teeth or gears cutting eccentric with bore. The clearance and the running of a pair of gears on correct center distances are also shown.

The sliding head is moved and set by means of a screw. A ratchet relief in the crank handle is provided as a safety device to prevent injury to parts by careless jamming of the gage or gears.

The screw controlling the sliding head is accurately cut, to minimize any error from expansion or contraction of which a 12-inch micrometer gage is furnished which may be used to check up the setting of the micrometer disk on the end of the screw. Any error either way from this 12-inch setting would probably not amount to one-quarter thousandth, (0.00025).

In checking the adjustment with the 12-inch micrometer gage, the screw on the micrometer or gage is used, setting the gage 11½ inches when ½-inch arbors are used, or 11 inches when 1-inch arbors are used.

The rail is graduated in a scale reading inches and tenths. The micrometer disk is graduated to read thousandths and a block on the head is graduated to read quarter thousandths. A gib adjusted by a thumb screw prevents possible lost motion in the sliding head upon the rail.

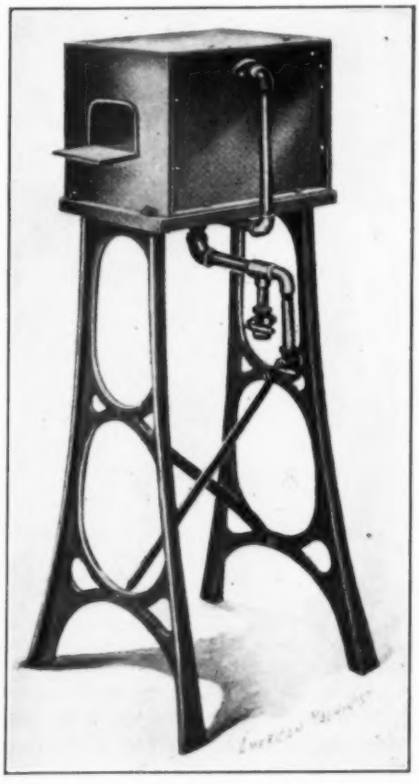
The collar supporting the screw in the stationary head is a series of collars with angular sides and runs as does the Acme thread screw in split babbitt nuts. The lower thumb nut in the head enables the nuts on screw and collars to be kept as tight and free from lost motion as consistent with free working of the screw.

Arbors are inserted in the vertical holes for testing center distances. A practical test for noise may be made by placing the arbors in horizontal position and arranging to drive by belt while center distance is adjusted to the point where the gears run best.

A shelf running the entire length of the bed is used to hold gages, arbors, bushings, etc., when machine is in use and a cabinet in the column provides room for storing these parts.

A Combination Forge and Furnace

The halftone shows a new combination forge and furnace which is being put

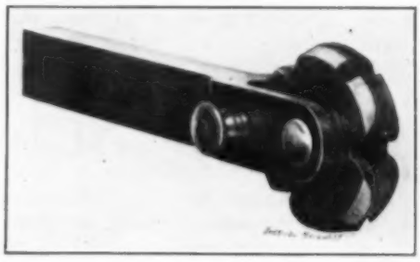


COMBINATION FORGE AND FURNACE

on the market by C. U. Scott, Davenport, Ia. In this furnace the work does not come in direct contact with the blast, for this reason heating is accomplished with the formation of considerably less scale than in furnaces where the blast strikes the work. The heating space is 4 inches wide by 9 inches deep.

The Miller Nurling Tool

The halftone shows a nurling tool with a rotatable head carrying six nurls. By means of the thumb nut the nurls can be locked in position so that they can be used either singly or in pairs. The nurls are tool steel, machine cut, the holder and turret are machine steel, pack hardened.



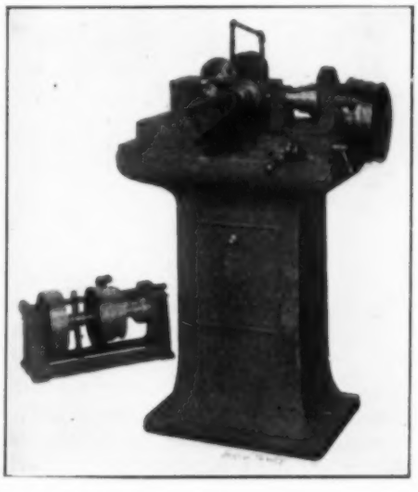
MILLER NURLING TOOL

It is made by the Miller Tool Company, New Britain, Conn.

Rochester Automatic Gear Tooth Rounding Machine

The machine shown in the accompanying halftone is a recent product of the Ingle Machine Company, Rochester, N. Y., built especially for chamfering the ends of teeth on all types of gears, including internal gears.

The machine is driven from a countershaft by two belts, one to the cutter spindle and the other to the cone pulley



AUTOMATIC GEAR TOOTH ROUNDING MACHINE

for feeds. A wide range of feeds and speeds is provided.

Three different methods can be followed in indexing the gear to be cut: First, the indexing can be done by duplicate gear meshing into feed-drive gear; second, it can be used to do its own indexing if meshed directly with

feed-drive gear; third, any gear meshed with the feed-drive gear will index all gears with the same number of teeth regardless of pitch.

Rounding of teeth is accomplished by a rotary motion applied to gear being cut, combined with reciprocating motion of the slide in which cutter spindle is mounted. The reciprocating motion is obtained by a cam operating a lever connected with the cutter slide. The cam lever is provided with index to locate position of the fulcrum stud for the different pitches of gears to be rounded.

The feed-drive gear is driven by a three-step cone pulley through worm and worm gearing; the three feeds provided allow for variations in material and pitch of gears to be finished; 10, 14 or 20 teeth can be indexed and cut per minute. A brake is provided and applied to the work spindle to take care of any possibility of back pressure of cutter.

Cutter spindle is driven by three-step cone pulley and speeds of 500, 700 and 1000 revolutions per minute are provided. The spindle is made of steel, hardened and ground. It is journaled in phosphor-bronze bearings provided with ring oilers.

Cutter head can be swiveled to right or left as desired, according to which side of gear is cut. The head is adjustable in and out by means of screw, and can be firmly clamped in cutting position. Cutters either single or double end can be used.

Milling Side Teeth in Cutter Blanks

By Harold Lamb

How to set the dividing head at the proper angle for milling side teeth in cutters.

A formula with which a table can be worked up to suit various sizes.

It is not often that a toolmaker is called upon to make a milling cutter unless it should be one of special size or type, these tools either being bought, or made in quantities by semi-skilled help under a "squad boss."

However, there are times when a toolmaker is called upon to make a milling cutter, and it is then that some knowledge comes in handy.

It happened that one day the man who had charge of the milling job was sick and did not turn up, so it fell to my lot to act in his stead until he returned. One of the many jobs he handled was milling the teeth in cutter blanks. As all toolmakers know, in order to mill the side teeth in straddle mills the blank is mounted on an index head and the head has to be offset a little in order to cut the "land" of the tooth parallel. I knew that somewhere around the foreman had a table, showing what angle to set the head at for different sizes of cutters, but I could not locate it anywhere, so had to help the man on the job to set his machine by cut-and-try methods.

After work, while thinking the matter over, I sat down and figured out a formula with which a table can be worked up to suit the sizes in use or for the man who makes an occasional cutter. When the other man returned I compared my notes with his table and they tallied.

I looked for help among the various handbooks which I have, but without avail. In view of this I think my figures may be interesting to others.

In the accompanying sketches, Fig. 1 shows how the index head is offset. The angle at which the head is set varies with the number of teeth to be cut in the blank and with the angle of cutter used.

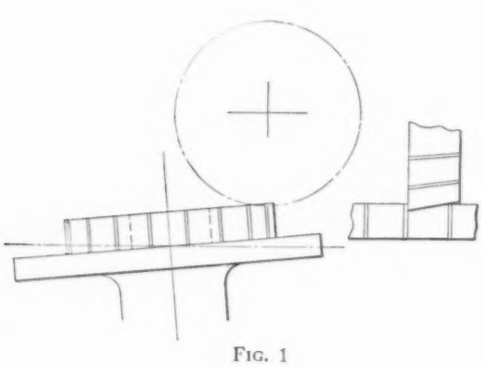


FIG. 1

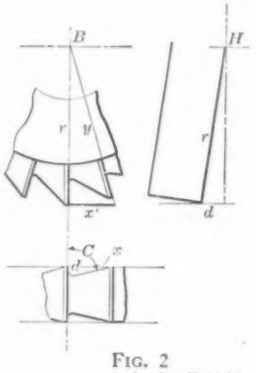


FIG. 2

American Machinist

SETTING THE DIVIDING HEAD FOR MILLING SIDE TEETH IN CUTTERS

Fig. 2 will show how this comes about.

H is the angle through which the head must be offset.

$$Sin.\ H = \frac{d}{r},$$

$$d = x\ cot.\ C,$$

$$r = y\ cos.\ B,$$

Therefore

$$Sin.\ H = \frac{x\ cot.\ C}{y\ cos.\ B},$$

but

$$\frac{x}{y} = sin.\ B,$$

so

$$Sin.\ H = \frac{sin.\ B\ .\ cot.\ C}{cos.\ B} = tan.\ B\ .\ cot.\ C.$$

C is angle of cutter used.

B is angle of tooth on blank $= \frac{360}{number\ of\ teeth}$.

A Visit to the Yale & Towne Plant

On Friday, September 16, the Yale & Towne Manufacturing Company entertained a number of representatives of the firms handling its chain hoists and of the press, at its factory in Stamford, Conn. The afternoon was spent in visiting the various departments of the plant, the main object being the demonstration of the good qualities of the Y & T hoist, as to the materials from which it is made, its design, the workmanship and the results obtained by its use.

The extent to which both the lock and the hoist business has grown could not but astonish all who were not closely connected with the plant, and the length of time which many of the men have been with the company was also surprising. The guests were well taken care of by Messrs. Allen, Hodgins, Spaulding, Regan, and others, and all secured a better understanding of the Y & T products than could be had in any other way.

New England Metal Trades

The Rhode Island branch of the National Metal Trades Association held their annual outing at the Warwick Club, on Narragansett Bay, September 21, 1910. Members and guests came from Boston, Worcester and New Haven, and all enjoyed not only the shore dinner but the games which followed. President E. A. Beaman, of the Rhode Island branch, welcomed the guests.

The general good feeling which prevails among the metal-working industries can be largely attributed to the personal contact due to meetings of this kind.

Filing the American Machinist

By A. K. Brown

Many readers of the American Machinist fail to get all the good out of their copies because they have no system of filing them for future reference, and when they are once put aside, they are never touched again, because of the trouble in finding the particular article one would like to review.

Many (myself included) find it too much trouble to keep a card index of the subjects. I have a large section of a catalog filing case in my office reserved for them and before putting them away, I mark the date and the names of two or three of the subjects which may be of future use, on the lower edge, so that when a copy lies face up the writing faces you. This makes it very easy to find what you want and takes very little time. You will find mine marked as follows:

Premium plan	"Lodge" 6/2/10	Gun barrels.
Tool stock room	5/6/10	Sub press.
Flying machines	5/19/10	Milling four throw cranks.

Another thing I would like to mention is that I invariably look carefully through the illustrated advertisements before going over the reading matter and can truthfully say it is time profitably spent.

Scholarships for Deserving Apprentices

Our recent suggestion regarding the awarding of scholarships to apprentices and other deserving young employees, has been anticipated by the Pennsylvania railroad.

They have recently announced the awarding of such scholarships to two young men, sons of employees, to enable them to pursue a college course. The examinations are competitive and the scholarship carries an allowance of $600 per year. The two just awarded make a total of eight scholarships of this kind which are now in force, which seems to indicate that the plan fulfils its mutual purpose of helping boys and promoting good will toward the company.

There can be little doubt that a system of this kind will do much to insure harmonious relations between the company and its employees, or that it will bring its reward by securing trained men who have every reason to be loyal to the best interests of the railroad.

Increasing Shop Capacities

Metal Working

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

NEW ENGLAND

Fire destroyed the foundry of Gray & Sons, at Poultney, Vt.

The Gurney Heater Company, Boston, Mass., manufacturing heaters and radiators, whose product is now being made outside, is arranging to erect a plant at South Framingham, Mass.

The Dual Tired Wheel Company, Westerly, R. I., has been incorporated to manufacture automobile and other vehicle wheels. Capital, $100,000. Incorporators, H. L. Stillman, S. E. Davis, Westerly; Frank Hill, Geo. B. Carpenter, Ashaway, etc.

Roche, Demar & Co., Springfield, Mass., has taken over the business of the J. S. Spencer Machine Company and S. L. Tallman & Sons Machine Company, of 21-23 Taylor street, which concerns did a general repair business and manufactured dies, models and experimental machinery.

MIDDLE STATES

The Brooklyn (Mich.) Cement Machinery Company is building a new plant.

The Marshall (Mich.) Furnace Company is preparing plans for a new factory.

Bartlett, Hayward & Co., Baltimore, Md., will erect a two-story machine shop.

The Victor Electric Company, Chicago, Ill., will erect another four-story building.

The Hancock (Mich.) Lubricator Company is considering the erection of a new factory.

Fire destroyed machinery in the engine house of the Erie railroad, at Salamanca, N. Y.

The Ewer Tool and Wrench Manufacturing Company, Howell, Mich., is erecting a new factory.

The American Sheet and Tin Plate Company will erect a new shop building at Kensington, Penn.

The Pittsburg (Penn.) Motor Car Company is looking for a suitable location on which to erect a plant.

The General Electric Company, Toledo, Ohio, is erecting a new four-story building to cost $125,000.

The Standard Company, Chicago, Ill., manufacturing ornamental iron, will erect a three-story factory.

The Vulcan Gear Works, of Detroit, Mich., will move to Pontiac, Mich., where a new plant is being erected.

The Globe Machine and Stamping Company, Cleveland, Ohio, will erect a new plant on West Seventy-sixth street.

The repair shop of the Duluth, South Shore and Atlantic Railroad, at Marquette, Mich., was destroyed by fire. Loss, $50,000.

The Delaware & Hudson Railroad is to build a new roundhouse and repair shops at Carbondale, Penn., at a cost of $850,000.

The Consolidated Gas, Electric Light and Power Company, Baltimore, Md., will erect a garage on Monument and Graves streets.

The C. R. I. & P. Railroad has awarded contract for the construction of a roundhouse at Burr Oak, Chicago, to cost $20,000.

The Calorific Heater and Manufacturing Company, of Allentown, Penn., is looking for a suitable site on which to locate a plant.

The Anderson (Ind.) Knife and Bar Company, whose factory recently burned, is considering rebuilding same at some other location.

The West Allis Iron Works Company, West Allis, Wis., organized a short time ago, will shortly award contracts for the construction of a foundry.

The Oliver Chilled Plow Works, South Bend, Ind., is now receiving bids on further additions to its plant, including a new chilled grind building.

The Ontario & Western Railroad has commenced work on a new roundhouse and other improvements at Mayfield, Penn., on which $100,000 will be spent.

The A. E. Russ Company, Cleveland, Ohio, manufacturing brass specialties, will erect a new plant to consist of three buildings—foundry, factory and power house.

The Cyriacks Motor Company, Eaton, Ohio, has been incorporated to manufacture motors, motor cars, accessories. Capital, $15,000. Incorporators, F. R. Cyriacks, F. R. Christman, etc.

The Isthmian Canal Commission, Washington, D. C., will receive bids until 10:30 a.m., October 14, for motor-driven engine lathe, valve-reseating machine as per Circular No. 606.

Tracy Laundry Machinery Company, Troy, N. Y., has been incorporated to manufacture laundry machinery. Capital, $100,000. Incorporators, Wm. H. Tracy, T. A. Devave, John T. Norton.

The U. S. Coupling Company, Columbus, Ohio, has been organized with $12,000 to manufacture pipe, pipe couplings, etc. Incorporators, W. V. Strickler, Horace Willoughby, J. P. Davis, etc.

The Walrath-Maxim Gas Engine Company, Jersey City, N. J., has been incorporated to manufacture gas engines. Capital, $100,000. Incorporators, H. O. Coughlan, L. H. Guenther, A. H. Jarvis.

The Dayton (Ohio) Electromobile Company has been incorporated by William Pflum, John L. Baker, H. G. Brentingler, etc. Plant for the manufacture of electric automobiles will be equipped.

The Browning Manufacturing Company, Mansfield, Ohio, has incorporated to manufacture cranes, shovels, etc. Capital, $200,000. Incorporators, L. C. Pelott, A. S. Meyer, Geo. F. Stalley, Jr., etc.

The Vermillion Novelty Company, Vermillion, Ohio, has been incorporated to manufacture iron and wooden novelties. Capital, $10,000. Incorporators, F. J. Stach, L. R. Clawson, E. J. Bryant, etc.

The Sowers Manufacturing Company, 1300 Niagara street, Buffalo, N. Y., is now erecting a three-story building for the manufacture of its oxygen generators and welding apparatus, vacuum pans, etc.

H. L. Slusser, of Columbus Grove, Ohio, and John E. Thomas, Delphos, Ohio, will erect a modern garage and repair shop on South Main street, Marion, Ohio, and will operate as the Cadillac Company.

The United States Indestructible Gasket Company, 50 Church street, New York, is erecting a new plant in Brooklyn for the manufacture of gaskets, washers, pumps, valves, stampings, metal specialties.

Warren Motor Sales Company, Toledo, Ohio, has been incorporated to do a general sales agency and automobile repair business. Capital, $40,000. Incorporators, S. P. Holmes, Chas. E. Davis, John McKenna, etc.

The United States Metal Desk Company, Utica, N. Y., has been incorporated to manufacture metal furniture. Capital, $10,000. Incorporators, J. Ellsworth Stille, E. J. Warner, Gloversville, N. Y.; S. M. Barney, Auburn.

The Rainbow Falls Horse Nail Company, Chesterfield, N. Y., has been incorporated to manufacture horse-shoe nails. Capital, $30,000. Incorporators, K. J. Severance, S. M. Foss, Keesville, N. Y.; G. S. Leavenworth, Troy.

The Morrison Automatic Flying Machine Company, Cincinnati, Ohio, has been incorporated to manufacture flying machines and motors. Capital, $10,000. Incorporators, S. S. Morrison, S. O. Needham, W. L. Buckman, etc.

The Mac Auto Company, Brooklyn, N. Y., has been incorporated to manufacture motor vehicles. Capital, $10,000. Incorporators, E. A. McShane, 5 Madison street, New York; Thos. McCauley, 70 Johnston street, Brooklyn, N. Y.

The Ashco Manufacturing Company, White Plains, N. Y., has been incorporated to manufacture bicycles, parts and accessories. Capital, $10,000. Incorporators, Robert W. Ashley, Clarence S. Ashley, Alfred S. Streuli, 50 Church street.

The Carbon Machinery Equipment Company, Rochester, N. Y., has incorporated to manufacture metal specialties, tools, etc. Capital, $30,000. Incorporators, C. B. Mayer, F. C. Buckley, Rochester; J. K. Smith, Honeoye Falls.

The Falls Rivet and Machine Company, Kent, Ohio, has been incorporated to manufacture rivets, washers, bolts and a general line of machinery. Capital, $150,000. Incorporators, Edwin Seedhouse, C. A. Weidner, H. C. Weidner, etc.

The Tyron Auto Pump Company, New York, has been incorporated to manufacture automobile tire pumps, etc. Capital, $10,500. Incorporators, Edw. E. Tyron, West Hartford, Conn.; Thos. Jacobs, Arthur W. Leonard, 328 West Fifty-seventh street.

The Isthmian Canal Commission, Washington, D. C., will open bids October 11, as follows: One engine lathe (schedule 2930), three geared head lathes, two flat turret lathes, No. 2 feed-screw wire machine (schedule 2909), one turret lathe (schedule 2919).

SOUTHERN STATES

H. T. Klugel, Emporia, Va., will erect a plant for the manufacture of tin and sheet iron.

The Pitts Agency, Birmingham, Ala., is looking for a suitable site for a large rolling mill.

The Hauser Manufacturing Company, Louisville, Ky., has been organized by Richard M. Hauser and others for the manufacture of brass goods.

WEST OF THE MISSISSIPPI

A machine shop is to be erected at Anaheim, Cal., by Redit & Angell, of Los Angeles.

The Jones-Everett Machine Works, Ardmore, Okla., will establish a foundry in connection with machine shop.

The blacksmith shop of the Valley Development Company, at Coachella, Cal., was totally destroyed by fire. It will be rebuilt.

City Councilman J. G. Park, of Murray, Utah, is interested in the proposed establishment of a tin-can factory at that place.

A machine shop 40x117 feet will be erected at Los Angeles, Cal., by the Kellar Thomason Manufacturing Company, of Covina, Cal.

The Sumner Iron Works, of Everett, Wash., is erecting a new plant in Burnaby, B. C., to consist of foundry, boiler shop and three erecting shops.

The Iron Mountain Railroad will build a new roundhouse at Baring Cross, Ark., to cost over $100,000. It will have a machine shop to be equipped with machinery worth about $35,000.

A commercial garage will be erected in San Bernardino, Cal., by Messrs. Rouse, Stewart & Garner, of Los Angeles. Modern equipment will be installed to handle repair work. Cost will be $6000.

The Griffin Wheel Company, Tacoma, Wash., has taken out a permit for the erection of an additional building. The wheel foundry will be doubled, new core room added and equipment installed for the manufacture of several kinds of car castings.

Machine, foundry and pattern-shop equipment will be required in the manual-training building of the new high school at Claremont, Cal. Bids will be asked on the buildings in October; the school is expected to be completed by the fall of 1911.

CANADA

The Cockshutt Plow Company will locate a big ranch at Saskatoon, Saskatchewan.

The Sumner Iron Works has secured a site for a large new plant at Burnaby, B. C.

Clare Brothers, of Preston, Ont., will more than double their stove-manufacturing works.

The Robertsonville Foundry Company is building a new plant at Robertsonville, Que.

The Hawthorne Silver and Iron Company will locate large plants near Kingston, Ont., for the manufacture of iron.

The MacLaughlin Carriage and Automobile Company, Oshawa, Ont., has awarded contract for the erection of a three-story factory building.

It is stated that much new machinery will be required in the new $100,000 addition to the plant of the Canada Cycle and Motor Company, at West Toronto, Ont.

The Ironclad Company of Canada, a branch of the Ironclad Manufacturing Company, of Brooklyn, N. Y., will erect a plant in Port Arthur for the manufacture of enameled kitchenware, etc. Robert Greig, Lumsden building, Toronto, is representing the concern. Large amount of machinery will be required.

GENERAL MANUFACTURING

NEW ENGLAND

The city of Providence, R. I., has asked for bids for a locomotive.

The Royal Mills, Riverpoint, R. I., is adding to its boiler equipment.

The Holmes Company, Robbinston, Me., is in the market for blowing machinery.

The Troy Mill, Fall River, Mass., will install a 1600-horsepower engine.

The Thomas Dye and Bleachery, Montville, Conn., is building an addition.

Riley & Hatch, Church street, Whitman, Mass., require steam-heating apparatus.

The Rhode Island Lace Company, West Barrington, R. I., will enlarge its plant.

The Quissett Mill will install a 3500-horsepower engine in its plant at New Bedford, Mass.

The Lybeck Company, Bristol, R. I., will purchase storage batteries, second hand if possible.

The Connecticut Mills Company has leased a factory at Danielson, Conn., and will install machinery for weaving.

The H. B. Smith Company, Westfield, Mass., manufacturing radiators, boilers, etc., will erect an addition to its foundry.

The American Textile Specialty Machinery Company, Providence, R. I., is planning to equip its plant with electric motors.

The plant of the Aquidneck Soap Manufacturing Company, Newport, R. I., was destroyed by fire. Loss, $30,000. Will be rebuilt.

E. D. Jones & Sons Company, Pittsfield, Mass., will erect a large woodworking shop. New boilers, engine and generator set will be required.

The Charlton Mills, Fall River, Mass., will install a 1500-horsepower reciprocating steam engine and a 850-horsepower low-pressure steam turbine.

MIDDLE STATES

The city of Guthrie, Iowa, voted to build a new pumping station.

The Texas Company, Bayonne, N. J., is to build a new power plant.

The Celluloid Company, Newark, N. J., will build an addition to its plant.

The N. Rassell Sons Company, Toledo, Ohio, is erecting a new power house.

The Newark (N. Y.) Wagon Company is building a new two-story factory.

The Combination Fountain Company, Decatur, Ill., is erecting new buildings.

The Oliver Chilled Plow Works, South Bend, Ind., will erect a new paint shop.

Fire destroyed the box factory of Thompson & Sons, at Hurlock, Md. Loss, $25,000.

The American Locomotive Company, it is said, has prepared plans for a new power house at Allegheny, Penn.

The Scott & Bowne Company, Bloomfield, N. J., will erect a new boiler and engine house.

The Menasha (Wis.) Woodenware Company is contemplating the removal of its plant.

Fire in the plant of the Kenyon Paper Company, Baldwinsville, N. Y., did $10,000 damage.

The Cheever Iron and Ore Company, Port Henry, N. Y., is in the market for a large compressor.

Charles Oppel's Sons will erect a power house and factory at 364-368 Jelliff avenue, Newark, N. J.

The city council, Baltimore, Md., has taken out a permit for a new pumping station to cost $148,800.

The Wheeler-Clough Company, Chicago, Ill.,

manufacturing varnishes, will erect a new $100,000 factory.

The Elizabethtown Smelting Company, Newark, N. J., will erect a new building at 503-505 Mulberry street.

The Recreo Chemical Company will erect a new factory at Lafayette and Washington streets, Utica, N. Y.

The Central Refining Company, Lawrenceville, Ill., contemplates adding more equipment to its pumping station.

Fire destroyed the plant of the Furnas Office and Bank Furniture Company, Indianapolis, Ind. Loss, about $50,000.

The Lignum Chemical Company has had plans prepared for a new plant to be erected on the Whitbesk site, Marinette, Wis.

The Simms Magneto Company, of New York, has purchased site at East Orange, N. J., on which a plant will be erected.

The Indian Refining Company, Lawrenceville, Ill., contemplates improvements which will involve an expenditure of over $1,000,000.

The Mutton Hollow Fire Brick Company, Woodbridge, N. J., will increase the capacity of its power plant. Will install new engine, etc.

The Lawrenceville (Ill.) Light and Water Company will soon add another filtering tank and expects to enlarge its entire plant next spring.

Fire destroyed the box factory of Becker Brothers & Son, at Frederick and Lexington streets, Baltimore, Md., causing a loss of $50,000. Plant will be rebuilt.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids October 4, for twist drills (schedule 2914), iron screws (schedule 2917), brass pipe fittings, copper tubing, drawn copper tubing, brass unions (schedule 2918).

Sealed proposals will be received until 11 a.m., October 19, at the chief quartermaster's office, Federal building, Chicago, Ill., for furnishing 3000 metal wall lockers. Full information can be had of Lieut.-Col. Thomas Cruse, chief quartermaster.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., October 17, for hose, packing, torpedoes, diaphragm pumps, valves, cocks, grease and oil cups, lubricators, scales, clamps, flue cleaners, screws, steel letters, etc., as per Circular No. 607.

The Duplex Piano Stool Company, Chicago, Ill., has been incorporated with $25,000 to manufacture piano stools. Incorporators, John Hegerhoist, Josef Holy, Albert Hoering.

The Isthmian Canal Commission, Washington, D. C., will receive bids until 10:30 a.m., October 14, for condenser, snatch block, punches and dies, valve-reseating machine, rivet sets, electric jaws, water gages, etc., as per Circular 606.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids October 4, for 12 chain hoists (schedule 2914), 13,500 pounds round drawn rod brass, 22,100 pounds naval round bronze (schedule 2928), 8200 pounds naval rod bronze, 15,306 pounds cold drawn steel, 16,000 pounds forged steel, 48,000 pounds machine steel, 30,100 pounds oil-hardened steel (schedule 2913); 2500 pounds sheet lead, 1000 pounds long-grain spelter solder (schedule 2917), 4600 pounds mild-steel plates (schedule 2918).

SOUTHERN STATES

The Danville (Va.) Knitting Mills will build a $10,000 addition.

The Big Sandy Milling Company, Louisa, Ky., will install an ice plant.

The Paducah (Ky.) Brewery Company will double the capacity of its ice plant.

Armour & Co. will build a $100,000 cold-storage plant at Birmingham, Ala.

The city of Haleyville, Ala., contemplates installing waterworks for fire protection.

The South Atlantic Packing Company, Savannah, Ga., will erect a cold-storage and abattoir.

The oar factory of Brown & Herlihy, at Denham Springs, La., was destroyed by fire. Loss, about $75,000.

The city of Jellico, Tenn., voted to issue bonds for $90,000 for the construction of waterworks system, etc.

The Kissimmee (Fla.) Ice and Cold Storage Company, recently organized, will erect a plant. R. O. Meek is secretary.

The Atlantic Ice and Coal Company, of Athens, Ga., contemplates establishment of a cold-storage plant in Elberton, Ga.

The Ferriday (La.) Hoop and Cooperage Company has awarded contract for the construction of a factory for making hoops.

WEST OF THE MISSISSIPPI

The Galveston (Tex.) Brewing Company will erect a modern ice plant.

Fire destroyed the refrigerating plant of the Valley market, at Coachella, Cal.

The Economic Gas Company, Los Angeles, Cal., is building an addition to its plant.

The city of Rogers, Tex., will vote on issuance of $14,000 bonds for waterworks.

The Aubry Wagon Company, Tacoma, Wash., will rebuild its plant recently burned.

The U. S. Packing Company, Wichita Falls, Tex., will erect a new plant to consist of 12 buildings.

The city of Ballinger, Tex., will vote on issuance of $20,000 bonds for improving and extending waterworks.

The H. Raphael Company, Los Angeles, Cal., manufacturer of glass, is making improvements in its factory.

A $75,000 factory will be erected for McMonies & Co., Portland, Ore., manufacturing harness, horse collars, etc.

The Throop Polytechnic Institute, at Pasadena, Cal., will build a reinforced concrete power house to cost $10,000.

The San Bernardino Fertilizer Works, of San Bernardino, Cal., will erect a modern fertilizer factory in Los Angeles.

A cannery is contemplated at Banning, Cal. It will be erected by Messrs. Mackey, Tripp and Hauverman, of Los Angeles.

M. G. Levy and S. A. Clark will build a reduction plant at the Ajo mines, south of Gila Bend, in Pima county, Arizona.

The Santa Fe Railroad Company will soon commence the erection of an electric-light plant at Barstow, Cal., to cost $75,000.

The Master Painters Supply Company, Los Angeles, Cal., contemplate the erection of a factory in this city for the manufacture of paint.

The Davenport Brick and Tile Company has been incorporated with $10,000 capital to build a plant in Davenport, Okla. Willis Moore, president.

The city of Denison, Tex., will vote on issuing $50,000 bonds to improve and extend waterworks, including new boilers, pumps, etc. A. W. Acheson, mayor.

Power-plant equipment will be required in the new hotel to be erected at Phœnix, Ariz., by the Adams Hotel Company. A refrigerating system will also be installed.

The San Diego (Cal.) Shoe Manufacturing Company, recently organized, has completed plans for the erection of a plant on Sixteenth street, between Logan and National avenues.

The Bellingham (Wash.) Manufacturing Company has been incorporated and will establish a plant for the manufacture of all kinds of woodenware. A. A. Adams is president.

The A. B. Steel Planing Mills, at Redondo Beach, Cal., have been purchased by the Montgomery & Mullin, and C. Ganahl Lumber Companies. The plant will be greatly enlarged by the new owners and additional machinery installed.

The Midway Light and Power Company has been incorporated at Bakersfield, Cal. Plants will be erected at Maricopa and Moron (near Bakersfield) for the distribution of light, heat and power. Headquarters of the company will be located at Los Angeles, Cal.

CANADA

Chippewa, Ont., will spend $30,000 for new waterworks.

Guelph, Ont., will spend $85,000 improving its street railway.

The Pattinson Woolen Mills, Preston, Ont., will double its plant.

Welland, Ont., has voted $52,000 bonds for waterworks extension.

Burnaby, B. C., will spend $80,000 equipping an electric substation.

Port Arthur, Ont., will equip a large electric power plant for civic purposes.

The Mendelssohn Piano Company, of Toronto, is building a large new factory.

The Burlington Blanket Company will equip a very large factory at Windsor, Ont.

The Consolidated Optical Company, of Toronto, is building a large new factory.

Penticton, B. C., will spend large sums for installing water, light and power plants.

Robert Greig, of Toronto, will locate a large enamel works at Port Arthur, Ont.

Chilliwack, B. C., is in the market for $20,000 worth of road-making machinery.

Port Credit, Ont., will spend $90,000 for electrical equipment for a new hydro power station.

The Canadian Silk and Cotton Company will equip a very large factory at Beauport, Quebec.

The Toronto Electric Light Company is spending $150,000 on new machinery and buildings.

The Fraser Valley Sugar Company will spend $300,000 equipping a plant at Mission City, B. C.

The Vancouver Sewer Pipe and Refractories Company will build a large plant at Vancouver, B. C.

The British Columbia Portland Cement Company will locate a $500,000 plant at Princeton, B. C.

The John Palmer Company, tanners, will locate a large new factory at Fredericton, New Brunswick.

The lumber and stave mills of J. S. Ainslie & Brothers, destroyed by fire at Comber, Ont., will be rebuilt.

The machinery rooms of the Telford Lumber Mills, at Leduc, Alberta, gutted by fire, will be reequipped at once.

Montreal is calling for tenders for an electrically driven 6,000,000 imperial gallon turbine or improved centrifugal pump.

C. A. Dunham & Co., of Marshalltown, Iowa, manufacturing heating and power-plant specialties, will erect a branch plant in Canada.

A. H. Caplom & Co., Ltd., Ottawa, Ont., will establish a three-story babbitt metal and solder foundry, together with a smelting and refining plant.

Swift Current, Saskatchewan, is in the market for pumping machinery (compressed-air system), electrical machinery and a producer-gas plant.

Business Items

Increased business has necessitated Chandler & Farquhar Company, of Boston, Mass., machinists' supplies and machine tools, securing additional quarters. It has leased a large store adjoining its present machine-tool warehouse and in the future its machinery office and salesroom will be located at 419 to 425 Atlantic avenue.

Joseph T. Ryerson & Son, of Chicago, have two new buildings in course of erection, one to be devoted to machinery warehousing and display and demonstration rooms, the other to the storage of structural shapes and specialties. The addition to the machinery-demonstration and display rooms is 350 feet long and 75 feet wide, of steel and brick construction with tile and glass roof. The floor is 3-inch planking crossed with matched hard maple over concrete. This building will be served by a 15-ton crane, spanning the full width of the building, the runways extending over double-switch tracks and a wagon runway at the south end of the building. This room will be wired for four different types of electric current and will further be piped for steam, gas and high-pressure water, which in addition to line shafting for belting will permit them to test or operate practically any kind of a machine. Concrete pits will be furnished for testing work that requires facilities of this kind.

Trade Catalogs

The Cincinnati Planer Company, Cincinnati, Ohio. Catalog. Planers. Illustrated, 48 pages, 9x12 inches, paper.

The Bryant Electric Company, Bridgeport, Conn. Catalog. Bryant and Perkins superior wiring devices. Illustrated, 120 pages, 6x9 inches, paper.

The Newall Engineering Company, Walthamstow, London, England. Catalog. Gages, micrometers and measuring machines. Illustrated, 64 pages, 6x9 inches, paper.

Forthcoming Meetings

International aviation meet, Belmont Park, Long Island, October 22 to 30. Auspices of the Aero Club of America, 29 West Thirty-ninth street, New York City.

National Machine Tool Builders' Association, annual meeting, October 25-26, Hotel Astor, New York. Chas. E. Hildreth, secretary, Worcester, Mass.

National Society for Promotion of Industrial Education, fourth annual convention, Boston, Mass., November 17, 18 and 19.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 295 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday, Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, Amer. Machinist.

The "Gas Saver" brazing forge; circular. J. L. Lucas & Son, 2 Fox St., Bridgeport, Ct.

Wanted—Work for screw machines and gear cutter. Box 775, American Machinist.

Wanted—Medium weight specialties or contract work. Wm. A. Cather, Pottsville, Penn.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—No. 1½ Pratt & Whitney hand miller, second hand. The Oster Mfg. Co., Cleveland, Ohio.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, Amer. Mach.

Those breaks on power plant or machinery! Are you going to lose time awaiting new parts from makers, or will you let us weld them at one-fourth to three-eighths cost of replacements? Re-shipment within 24 hours. Oxy-acetylene process, producing homogeneous weld of cast iron. No charge unless successful. Waterbury Welding Works, Waterbury, Conn.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Draftsman wanted; experienced, mechanical draftsman; designer of special jigs and fixtures for milling and drilling machines. Apply Union Typewriter Co., Bridgeport, Conn.

Wanted—Salesmen to handle on a generous commission basis, a well advertised and quick selling line of lathe tools; commissions given on all orders received from prescribed territory; send references with reply. Address "R. T.," American Machinist.

Wanted—Salesman experienced in machinery or electrical lines to sell new line of portable electric tools on liberal commission basis; will allow definite territory to the man who will really work it; we know what can be done with this line and want a hustler to do it. Box 946, American Machinist.

ILLINOIS

Wanted—An energetic tool room foreman; must be a pusher and a good executive, capable of assisting in the design of high-grade tools, principally telephone work; company located in Chicago; steady position; give age and experience. Box 14, Amer. Machinist.

MASSACHUSETTS

Toolmakers and machinists wanted; only first-class men experienced on special small tools and machines; also experienced automatic machine operators; state kind of automatic operated; steady employment; open shop; no labor troubles; Boston, Mass. Box 993, American Machinist.

Wanted—High-grade designing draftsman with large experience in steam engineering practice for permanent position with a large manufacturing concern in Massachusetts. State age, education, experience and salary expected by addressing Chief Draftsman, Box 950, American Machinist.

Wanted—Salesman experienced in machinery or electrical lines to sell new line of portable electric tools on liberal commission basis; will allot definite territory to the man who will really work it. We know what can be done with this line and want a hustler to do it. Box 945, American Machinist.

Superintendent wanted for a plant in Massachusetts employing 700 men all told; he must be a young or middle-aged man with plenty of ginger, energy, hustle and ability to get there, and must be thoroughly conversant with uptodate iron foundry and machine shop practice, machine shop in particular, on medium and fairly large work, and must be able to practice and to conform to modern methods of shop system, a snappy cost-reducing man not without ideas of his own; write fully and comprehensively, stating age, education, experience, compensation at which you would start, references if you wish us to write to any, and giving such information first hand as will enable us to make a tentative selection. Box 996, Amer. Machinist.

MICHIGAN

Salesman to solicit special screw machine products as side line, liberal commission to competent man. Address Michigan Products Co., Grand Rapids, Mich.

Wanted—A rapidly growing concern in town of 30,000 wants man with technical education along steam engineering lines. Box 997, American Machinist.

Wanted—At once, draftsman with at least two years' experience on gasolene engine and engine jig work; none but first-class man need apply. Box 917, American Machinist.

NEBRASKA

Wanted—One machine room foreman; one expert cost accountant; one assembling department foreman, one with experience on automobile friction transmissions; all must be men with several years' experience in similar positions; men 35 to 45 years of age preferred. Box 963, American Machinist.

NEW JERSEY

Draftsmen are paid $30 to $50 weekly; complete course at your home; four months. Draftsman, 404 Union Bldg., Newark, N. J.

Wanted—Salesman familiar with the sale and manufacture of some good special line of machinery capable of profitable development for a modern plant. Address "Practical," American Machinist.

Wanted—Mechanical engineer, familiar with some good line of machinery which could be taken up and developed by a well equipped foundry and machine shop. Address with particulars, "Reliable," American Machinist.

NEW YORK

Draftsman—Experienced on tools, jigs and fixtures. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn.

Experienced operator for Lucas boring mill for night shift. Apply Mergenthaler Linotype Company, 44 Ryerson St., Brooklyn, N. Y.

Wanted—First-class toolmaker; must be a rapid workman, able to make accurate tools without useless finish. Box 4, Am. Mach.

Thoroughly experienced draftsmen on gas and oil engine work; state age, nationality, training, full details, last 5 years' work with salaries received. Box 11, Amer. Machinist.

Designer, expert on all kinds of punches and dies, capable of planning work and designs for draftsmen; state experience, nationality, references and salary expected. Box 994, American Machinist.

Wanted—Steam and board drop hammermen; state experience and where employed last; also a drop-forge foreman; must be A-1 man. Address reply to Superior Motor Vehicle Co., 1449 Niagara street, Buffalo, N. Y.

Wanted—Toolmakers, first class on model and special automatic machine work; good pay and steady work to competent men; give age, experience and reference; vicinity of New York City. Box 978, American Machinist.

Foreman wanted for department using Gridley automatic, Potter & Johnston semi-automatics, Warner & Swasey hand screw machines; must be a hustler and good producer in quantity of high-grade work; applications strictly confidential. Box 960, Am. M.

Wanted—Foreman for machine tool department, about 50 hands, steam and gas engine factory; applicants must be thoroughly experienced in handling men and equipment; state age, experience and references. Box 15, American Machinist.

Wanted—Assistant superintendent wanted for automobile factory; must have practical knowledge of machinery, be a hustler and good producer in quantity of high-grade work; give full information as to experience, etc.; applications treated strictly confidential. Box 959, AMERICAN MACHINIST.

A skilful pressman, experienced in laying out operations, in making punches and dies, and in handling both power and hydraulic presses; an ambitious man able to handle men; will be in line for foreman of press department; plant is in eastern New York State. Box 7, AMERICAN MACHINIST.

NORTH DAKOTA

Mechanical engineer and instructor to teach experimental engineering, kinematics as assist with machine design in state university; salary one hundred dollars for nine months; to insure reply send photograph, state age, nationality, condition of health, college degree and full statement of qualifications, also references. Address Calvin H. Crouch, Dean, Grand Forks, N. D.

OHIO

Melter wanted in a grey iron foundry melting twenty tons per day. Address Box 957, AMERICAN MACHINIST.

Superintendent for general machine shop with kindred branches; must be familiar with modern methods, systems and shop accounting; technically educated preferred; give full particulars first letter. Box 998, AM. MACH.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Floor hands and fitters on machine tool work. Colburn Machine Tool Co., Franklin, Penn.

Wanted—First-class foreman to take charge of assembling; must have had a satisfactory record as foreman; will pay $125 per month. Box 953, AMERICAN MACHINIST.

Wanted—Draftsman, with experience in designing horizontal double-acting ammonia compressors; state age, salary and experience. Box 969, AMERICAN MACHINIST.

Wanted—First-class man as inspector; one with some automobile experience preferred; first-class position for man who can come well recommended. Box 954, AMER. MACH.

Wanted—Planer hands competent to produce maximum amount of work on medium and large planers; to such men we can offer steady employment, 60 hours per week; good wages; in answering state age and experience; location western Pennsylvania. Box 987, AMERICAN MACHINIST.

Wanted—First-class assistant superintendent in machine shops employing about 300 men; must have engineering ability and capable of producing economical results on jobbing work, as well as thoroughly understanding the operation of machine tools; address reply, stating age, experience, salary expected, etc. Box 967, AMERICAN MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WISCONSIN

Wanted—Draftsman, bright young man to take charge of a small drafting room. Address "A. Z.," AMERICAN MACHINIST.

Foreman wanted for monitor department; must be strictly first class in every respect, none other need apply; steady work and good pay for the right man. Address Box 934, AMERICAN MACHINIST.

FOREIGN

The Commonwealth Government, Commonwealth Offices, 72 Victoria street, London S. W., invite applications for a manager of small arms factory, Lithgow, New South Wales, Australia. Age not to exceed 45. Testimonials, statement of service and qualifications for post required. Previous experience of manufacture of small arms essential. Candidates have to undergo medical examination. Salary £750. Applications to be addressed Secretary, Defence Department, Melbourne, Australia, to arrive not later than October 31.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—Position as general superintendent; have had a large experience designing and building gas engines. Box 925, AM. MA.

Situation Wanted—Mechanical superintendent and shop systematizer; splendid record as a producer on light and medium weight machinery; experienced as chief draftsman, master mechanic and production engineer; familiar with gas engines and automobile parts; now employed by a large house making metal specialties as general superintendent; experience with building and starting new factories. "Designer," 3264 Fulton St., Chicago.

MASSACHUSETTS

Factory manager, successful, experienced in organization, cost and factory systems, desires change; can produce results and stand on own record, and give best references from present and past employers, also satisfactory reason for changing. Box 9, AMERICAN MACHINIST.

Superintendent or foreman; am a practical foundryman with a wide experience on heavy and light machinery, engine and jobbing work; thoroughly understand the cupola and mixing by analysis; understand handling men to advantage; married, sober, reliable; over twenty years' experience as such; best of references. Box 995, AMERICAN MACHINIST.

Mechanical superintendent with large automobile company manufacturing high-grade cars, desires change; just completed tools for 1911 model and installed additional equipment for same; 16 years' broad experience; thoroughly familiar with the manufacture of automobile parts and accessories; rapid production, interchangeability my specialty. Box 2, AMERICAN MACHINIST.

NEW JERSEY

Draftsman, experienced on tool work, also shop experience, desires to change. Box 988, AMERICAN MACHINIST.

Assistant superintendent or chief draftsman; accurate hustler; American; 37; seven years' shop and 15 years' office experience on keyboard and automatic machinery; excellent references. Box 272, Dumont, N. J.

Mechanical engineer, technical education, 22 years' experience in hydraulic, pneumatic and general engineering, shop work, etc., desires position as chief engineer or master mechanic. Box 962, AMERICAN MACHINIST.

Wanted—Position as draftsman by man experienced in the design, erection and operation of suction gas producers and gas engines; trade school graduate and International Correspondence Schools student; present salary $1080; age 23. Box 985, AM. MA.

NEW YORK

Machine shop foreman looking for a position, up to date and a hustler; first-class references. Box 10, AMERICAN MACHINIST.

Draftsman, experienced detailer on special machinery and model work; 8 years' shop experience. Box 3, AMERICAN MACHINIST.

Draftsman with long experience in machinery and mill work, wishes position; New York or vicinity. Box 981, AMER. MACHINIST.

Designer of special machines, tools and fixtures, technical graduate with shop experience, desires position; location immaterial. Box 5, AMERICAN MACHINIST.

Mechanical engineer wishes to connect with reliable party in a capacity of supervising the design and construction of automatic machinery. Box 8, AMERICAN MACHINIST.

First-class practical tool designer on automobile and interchangeable parts, capable of taking charge; salary $24 to locate in Greater New York or vicinity. Box 12, AMER. MACH.

Mechanical superintendent of a large manufacturing plant, with twenty years' experience in general machine and foundry practice, desires making a change. Box 901, AMERICAN MACHINIST.

Mechanical engineer, experienced in tools, operations, equipment and time setting, 12 years' experience in responsible manufacturing and commercial positions, desires change. Box 980, AMERICAN MACHINIST.

German machinist and toolmakers, 36 years of age, 18 years' experience in tools, jigs, automatic machinery, experimental work, also die work, wants steady position in New York or vicinity. Box 13, AMERICAN MACHINIST.

Brass and bronze foundry superintendent desires position; experience 16 years foreman, machinery, plumbers' supplies, chandelier, steam and water and art bronze; A-1 metal mixer. Box 971, AMER. MACHINIST.

Bookkeeper, American, 32, married, twelve years' thorough experience manufacturing, mercantile lines, reliable, competent, employed as accountant in automobile manufacturing plant, desires to relocate; highest references. "R. C.," Box 992, AMERICAN MACHINIST.

High grade designer with wide experience, both practical and technical, on tools and special machinery for manufacturing interchangeable parts; expert on dies, including subpress; will be open for engagement October 1; location immaterial. Box 915, AMER. MACH.

Sheet metal superintendent and factory manager desires change; vicinity New York; expert in steel, brass and metal stampings every description; uptodate tools, dies and special devices for same; capable executive; fully competent. Box 974, AMER. MACHINIST.

Superintendent and works manager by high class production engineer, expert on efficiency methods of organizing help and engineering the reduction of costs and raising of outputs; mechanical engineer by profession; expert at tools, dies, machinery and estimating; good reference for past performance. Address "Production," AMERICAN MACHINIST.

Mechanical superintendent, superintendent of maintenance; superintendent of power plant or consulting engineer; assume full charge of power plant, manufacturing machinery, buildings, etc.; capable of taking a load off manager's shoulders; first-class mechanical engineer, experienced, good education, will consider other mechanical, executive or confidential position; willing to travel, but no salesman's position wanted; bonds if needed; be explicit in your reply. Box 933, AM. MA.

OHIO

Foreman tool and diemaker or superintendent; a thorough expert on the design of all classes of the most uptodate methods of diemaking, tools, jigs, etc.; good organizer with executive ability in shop management; excellent references and recommendations. Box 975, AMERICAN MACHINIST.

PENNSYLVANIA

Works manager or superintendent desires change; can show results in manufacturing either light or heavy work, as I am capable of bringing a factory strictly up to date without excuses. Box 961, AMER. MACHINIST.

General foreman or foreman experienced in the manufacture of interchangeable high-grade engine or machine production; 17 years' experience; 33 years of age; modern shop methods; organizer and executive of tact; thorough mechanic and hustler. Box 1, AM. MA.

WISCONSIN

High-grade designer of special automatic machinery wants position offering good prospects; inventive ability; good mechanic and executive; developing and perfecting machinery a specialty; at present in charge. Box 999, AMERICAN MACHINIST.

FOR SALE

For Sale—Air compressor, 177 cubic feet per minute; Ingersoll-Sergeant simplex, size 10x10¼x12. Box 6, AMERICAN MACHINIST.

For Sale—Screw manufacturing business; excellent opportunity and profits; reasonable price; first-class machinery. Box 913, AM. M.

For Sale—One 3x36 Jones & Lamson; this machine is of late type, full turret, shifting hob, complete with full set of chucking and bar equipment. Wanted—A medium size plain milling machine; also 24-inch drill press; will buy, sell or trade. Quride Co., Syracuse, N. Y.

For Sale—Three return tubular boilers, manufactured by Riter Bros., Buffalo, N. Y. Drums 72x16 feet 0 inches; each boiler with sixty-six 4-inch tubes; inspected by Travelers Indemnity Company, of Hartford, Conn; 93 lb. steam pressure; boilers in good condition; can be delivered in two to three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

For Sale—Established machine tool business in the north of England; valuable patents and modern plant; will prove a first rate addition to an existing business or nucleus for foreign patentees requiring established business and works; leases and options in buildings transferred if required. Communications from principals only to be addressed in first instance to "M. T. Business," Care Messrs. Patersons, Snow, Kinder & Lawson, 25 Lincoln's Inn Fields, London, W. C., England.

Talks With Our Readers

By the Sales Manager

AMERICAN MACHINIST,
New York, N. Y.

Gentlemen:

Two young men working at the machinist trade in our plant are ambitious to become machinery salesmen and we have arranged for them to spend one day out of each week in the office, and the first work we set before them on that day is to go through the AMERICAN MACHINIST from cover to cover—thought you would like to know that your paper was serving as a text book for salesmen in our establishment.

Yours very truly,
THE CINCINNATI PLANER CO.

* * *

The business of selling has changed wonderfully in the last five years. The strenuous selling age is here.

How to get big net profits out of business, how to get more orders at less expense, how to lessen the hardships of selling; these are the problems that now confront every distributor.

The time is past when the hot air artist can inveigle orders from any of us.

The salesman must be well armed with proper information and proper arguments to meet all objections that may arise.

For objections do arise; in fact, every probable purchaser is on the defensive.

Every one of us must be shown—and we want to be shown without too much of our time being taken up.

And this is why advertising is revolutionizing the selling methods of today.

Yet 'tis sad, but only too true, that salesmen have done more than anything else to obstruct the development of advertising.

They treat it worse than a man does his red-headed stepchild.

They should welcome its help—make use of it in every way.

It is one of the most important members of the army of distributors—it is the scout ahead of the firing line.

Its duties are many. Chief among them is the uncovering of new prospects, creating in their minds a desire to know more about the article offered, and inducing them to ask for further information.

It puts the salesman in touch with the prospect, makes his approach far easier and his arguments more effective.

It searches throughout parts of his territory, brings to light possible customers whom he has never heard of, in places he never would have thought of, and at times most unexpected.

Frequently it points out the man with a change of heart who has often turned him down.

And when the competitor comes along and puts a crimp in his plans, it is the silent scout that puts in a good hard lick, driving home a shaft of convincing argument for him—often the lick that brings him back to get the order.

The scout searches out new prospects, preaches economy, gives information, the "reason why," and creates a desire to purchase.

Then it's up to Mr. Salesman to capture the order. The scout has done its duty when it has brought salesman and purchaser in touch.

When it has, then it is entitled to the thanks of both—

Of the salesman on account of the educational work it has done.

And of the purchaser because it shows him a machine that will enable him to do better, faster or cheaper work.

* * *

Say you saw it in the American Machinist.

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The operating of the chuck and the feeding of the stock are both accomplished by the movement of one lever on

No. 0 Wire Feed Screw Machines

Furthermore the chuck automatically compensates for any ordinary variations in the size of the stock so that accurate and uniform feeding is secured at all times.

The importance of these points cannot be overstated. With machines of this type where the object is the production of small quantities of duplicate parts as opposed to the field of the automatics, every advance made in the direction of economy of operation should be noted. The quicker a wire feed screw machine can be operated and the handier the adjustments the more valuable the machine.

Send for circular giving full particulars.

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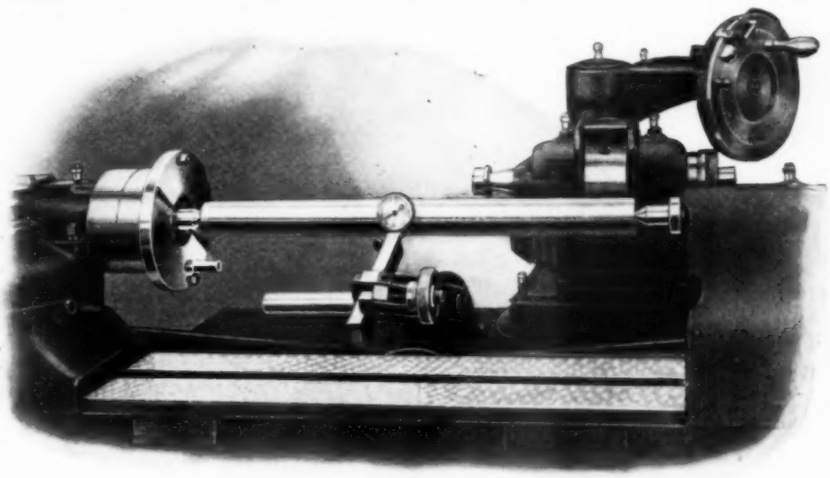

Testing Alignment of Centers with Grinding Wheel Carriage

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Walter H. Foster & Co., *Managers.*

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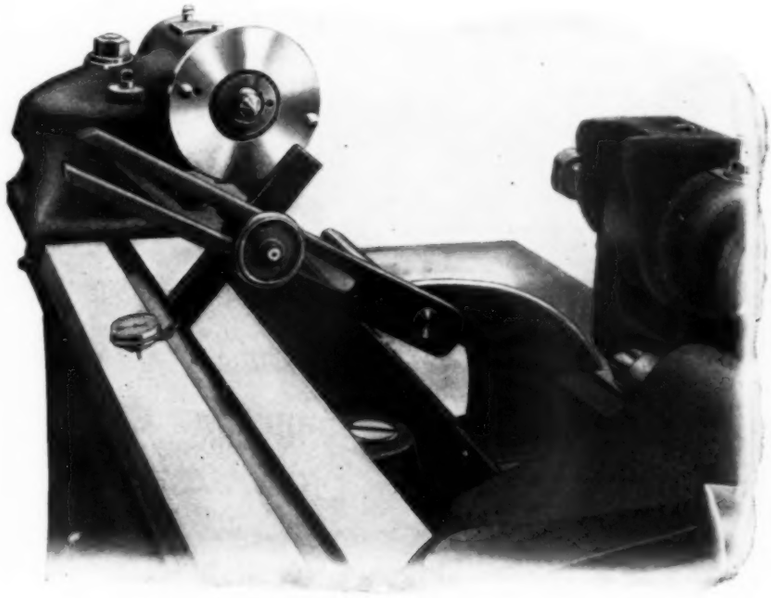

Testing Surfaces of Table for Parallel with Travel of Carriage

Our Test Is A Regular "Third Degree"

If tests have anything to do with the accuracy of a finished grinding machine then the **Landis Grinder** is as accurate as human skill and ingenuity can produce. Every part of every Landis Grinder has to submit to the most careful tests before we are satisfied that it conforms to the Landis "Standard."

This explains why Landis Grinders are noted for such accuracy, and why a "Landis" does such precise work.

Write for full particulars. Landis Grinders will reduce your manufacturing costs—and we can prove it. Your samples or drawings will give us the data to work from.

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55 and 4th cover
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Greenfield Machine Co..... 80
Heald Machine Co..... 79
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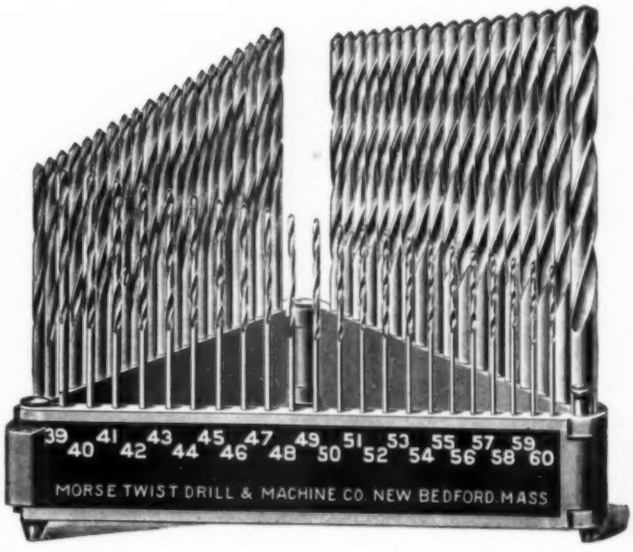

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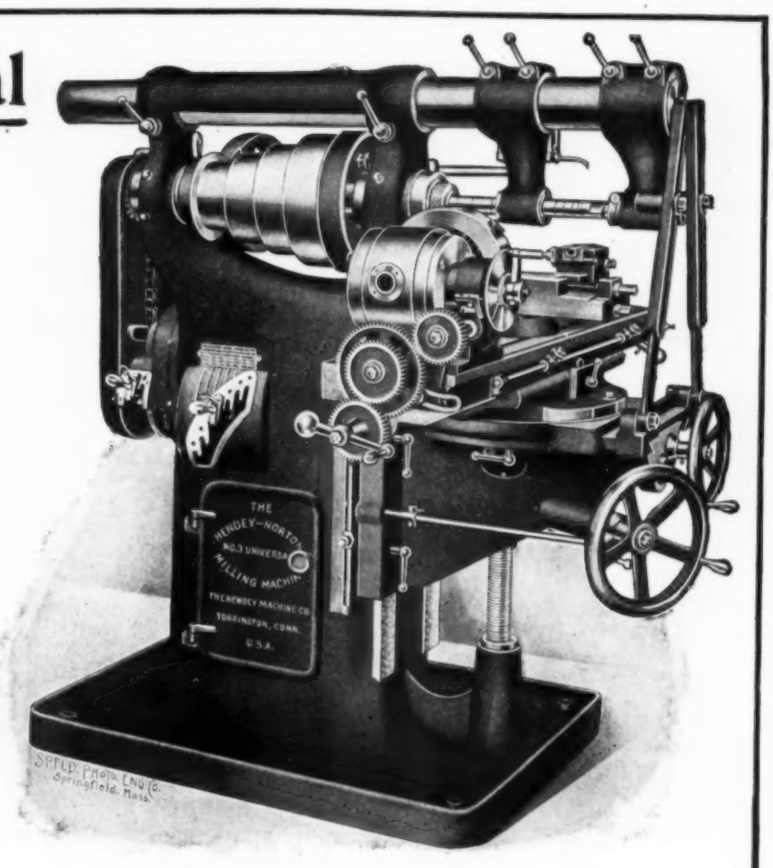
No. 3 Universal Miller



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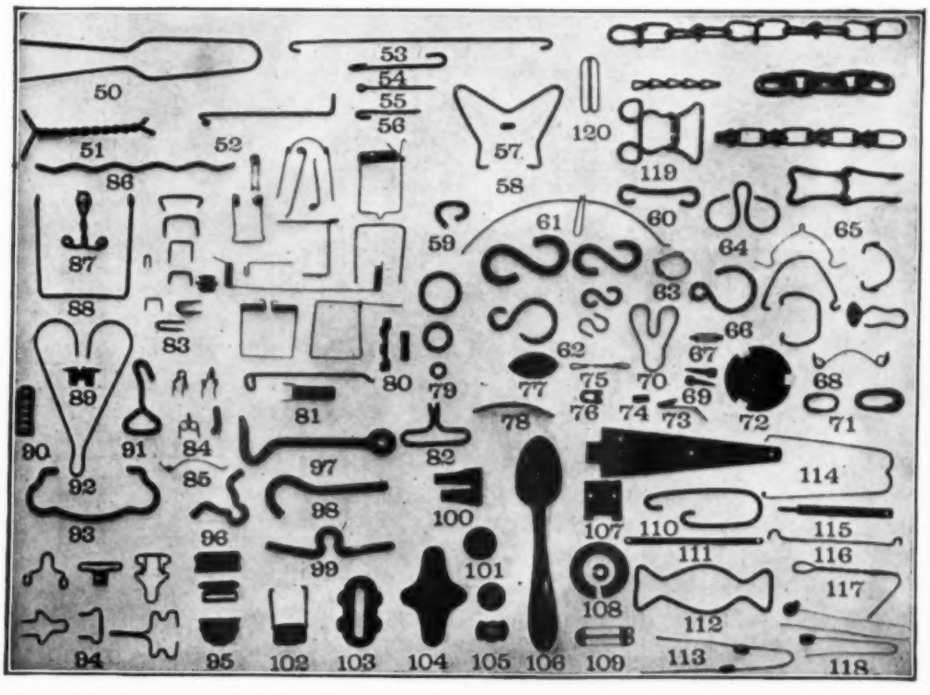

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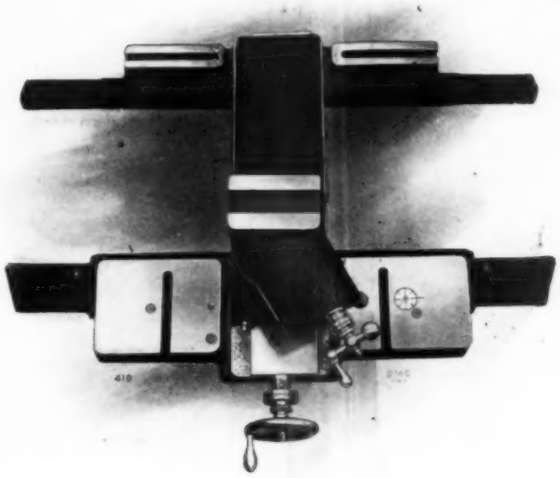

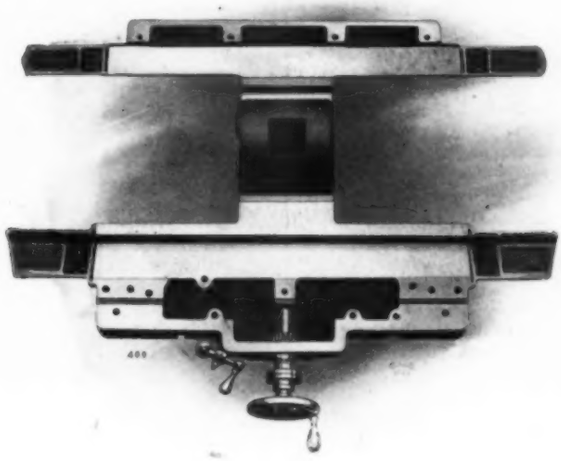

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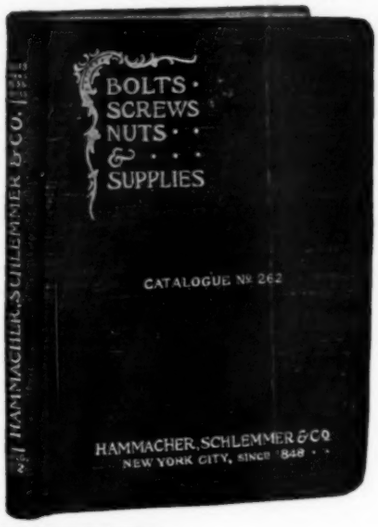

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They are adapted for heavy work and will stand up under extraordinary conditions.

The locking device for the teeth is the most positive we know of.

We have known of cases where accidents have happened which put fixtures and arbor out of commission and twisted cutter but we never knew a tooth to move or become loosened.

Prices quoted on request.

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The Cutter Makers

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FOREIGN AGENTS: France: Alfred H. Schutte, 22-24 Rue de Petits Hotel, Paris. England: Chas. Neat & Co., 112 Queen Victoria St., London. Agents for Sweden: Wilh. Sonesson & Co., Malmo, Stockholm and Gothenburg. Agents for Denmark, Norway and Finland: Aktieselskabet Wilh. Sonesson & Co., Copenhagen City and Freeport. Australia: Thos. McPherson & Son, Melbourne. Agents for Germany: Schmidt & Clemens, Frankfort, a./m. Japan: Andrews & George, Yokohama.

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